IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

VLSI TECHNOLOGY LLC *
*
VS. * CIVIL ACTION NO. W-21-CV-57
*
INTEL CORPORATION * February 26, 2021

BEFORE THE HONORABLE ALAN D ALBRIGHT, JUDGE PRESIDING
JURY TRIAL PROCEEDINGS
VOLUME 5 OF 7

APPEARANCES:

For the Plaintiff:
Morgan Chu, Esq.
Benjamin W. Hattenbach, Esq.
Alan Heinrich, Esq.
Ian Robert Washburn, Esq.
Amy E. Proctor, Esq.
Dominik Slusarczyk, Esq.
Charlotte J. Wen, Esq.
Jordan Nafekh, Esq.
Babak Redjaian, Esq.
Irell & Manella, L.L.P.
1800 Avenue of the Stars, Suite 900
Los Angeles, CA 90067-4276

J. Mark Mann, Esq.
Andy W. Tindel, Esq.
Mann, Tindel & Thompson
112 East Line Street, Suite 304
Tyler, TX 75702

For the Defendant:
William F. Lee, Esq.
Joseph Mueller, Esq.
Louis W. Tompros, Esq.
Felicia H. Ellsworth, Esq.
Jordan L. Hirsch, Esq.
WilmerHale
60 State Street
Boston, MA 02109

Mary V. Sooter, Esq.
Amanda L. Major, Esq.
Wilmer Cutler Pickering Hale Dorr LLP
1225 17th Street, Suite 2600
Denver, CO 80202

J. Stephen Ravel, Esq.
Kelly Hart & Hallman LLP
303 Colorado Street, Suite 2000
Austin, TX 78701

James Eric Wren, III, Esq.
Baylor University Law School
One Bear Place #97288
Waco, TX 76798-7288

Court Reporter: Kristie M. Davis
United States District Court
PO Box 20994
Waco, Texas 76702-0994

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08:09 (February 26, 2021, 8:10 a.m.)

08:10 THE BAILIFF: All rise.

08:10 THE COURT: Good morning, everyone. You may be seated.

08:10 MR. CHU: Good morning.

08:10 THE COURT: Before you all start, let me tell you I spent the evening reviewing the depositions. With respect to -- let me make clear I only read them with respect to the issue of Fortress. So if there are other issues that you all were concerned about with regard to what's in the depositions that Intel wants to play other than Fortress, I did not do that.

08:11 But with respect to Fortress, the Court is going to not permit the issue of Fortress to come into the trial. And so anything -- any reference to Fortress that is in the depositions, those portions need to not appear in front of the jury.

08:11 Mr. Lee, what I would suggest -- but you need to protect your record -- since you all were going to present the Fortress issues I think exclusively by deposition testimony because of the absence of the witness, what I would think would be the most efficient way is you -- we already -- you already have a roadmap of what you wanted to put in.

08:11 And if we could have an agreement that that's what you would have put in at trial had I permitted it, to protect your record as opposed to actually reading it, that's what I would prefer.

08:12 MR. LEE: I think, Your Honor, what we'll do is make you a proffer so we have a record because we would have offered some testimony of witnesses as well.

08:12 Your Honor, I do want to say one thing for the record though because we now have this cycle that you saw in the opening and we have Mr. Spehar and Mr. Bearden suggesting that everything that VLSI recovers --

08:12 (Clarification by the reporter.)

08:12 MR. LEE: I'll be looking at Kristie to get signs.

08:13 Your Honor, we will make the written proffer, but I just want the record to be clear this puts us in a very, very difficult position because from the outset, there's been a suggestion that what VLSI does is generate revenues for NXP.

08:13 It's not true. It's not even the majority of the revenues that go to NXP. They go to other people. And allowing them to make the argument that this is all fueling research and development for NXP is prejudicial to us.

08:13 THE COURT: I understand. But I've said -- it may or may not appear to you all, but I've actually been paying attention pretty carefully during the trial. I disagree. I don't think that was the impression I got. I've gotten -- I've listened very carefully to see if the plaintiff was going to open the door. That's not the impression I've gotten is that all the money is going -- in fact, one of your attorneys questioned someone about where the money was going, and the answer was

08:14 generically: I don't really know, but I think that some of
08:14 it's going to universities, but I don't know where else it's
08:14 going.
08:14 And I just -- I disagree on the relevance. I thought a
08:14 lot about it, and you can make your proffer.
08:14 MR. LEE: We'll make the proffer. I just want to make
08:14 that point in particular as we approach the closings is an
08:14 issue, and to be fair, Your Honor, there are already exhibits
08:14 in evidence that say Fortress. Because Fortress is the one who
08:14 signed the purchase agreements for these patents --
08:14 THE COURT: I understand, but I'm not going to allow the
08:14 questioning about Fortress.
08:14 MR. CHU: On that particular exhibit --
08:14 THE COURT: Mr. Chu, let's get through everything else.
08:14 One, I would -- I'm usually reluctant to tell someone of either
08:14 of your statures what to do, but this is one where you've won.
08:15 So you can't help yourself.
08:15 (Laughter.)
08:15 MR. CHU: I was going to move to another issue. Thank
08:15 you, Your Honor.
08:15 One is very short. Yesterday or the day before there was
08:15 a question about an extension of time to respond to the motion
08:15 by VLSI to transfer Case 2 and 3 from Austin.
08:15 THE COURT: I've checked. The judges in Austin have not
08:15 yet decided on April. I've asked the judges to get back to me

as quickly as possible. What -- I don't know what this does exactly with regard to the immediate issue of when Intel needs to respond, but I don't think I will be able to allow Intel to have until the date they wanted for response. In this sense what my plan is is as follows: If I don't hear -- when is the trial set? On the 14th?

MR. CHU: I thought it was April 12th.

THE COURT: Well, so what I'm planning to do is this for right now, and this isn't -- this is not helpful to anyone. I'm going to wait until the 12th of March. If the case can be tried in Austin, I'll -- if I can -- am permitted to try it in Austin in April, I'll do that, but I will tell you I am extraordinarily skeptical in that if I don't know by the 12th -- if I don't know a month out, I'm going to try it here.

MR. CHU: Could I ask if -- I appreciate the Court's feeling on this. There are practical issues that our client has asked us about in terms of locales and if it could be the 9th or the 8th just because of cancellations.

THE COURT: No. Whatever -- that's what I -- I appreciate that. I'm trying to make it so that the deadline for me to have to -- the deadline for me to default -- to default to Waco is whatever prejudices the parties the least.

And so let me put on the record I am completely agnostic. I am -- I made the decision to put the case in Austin. If Austin is available, I'm happy trying it there. They've got a

lovely courtroom.

You all can -- we can try it there, but that decision has to be made in a way that doesn't prejudice the parties. So I'm happy to make it March 8th that if I don't -- if the judges in Austin cannot tell me that we can go to trial in April by March 8th, then I'm going to set it for trial in Waco. On the date -- I'm going to maintain the date -- I'm going to maintain the date either way, but it will be in Waco if I can't tell you all by the 8th it will be in Austin.

MR. CHU: Thank you.

THE COURT: And I have implored -- is that the right word -- I think it's right -- I've implored the judges in Austin for what you're saying. I've told them this is not something that we can just -- we can't -- they can't tell me how on -- I'm not putting them down, but they can't tell me on March 30th that, okay, we're going to go to trial and you can have trials in April, and you guys can just say okay. I mean, I'm moving two armies into the battle field. So the 8th sounds reasonable to me.

MR. CHU: Thank you.

Different issue. Dr. Grunwald is coming up today. It may be this morning. And the -- some of their slides we have a number of objections. One of the most substantive problems and objections is they want to refer to two Intel patents. Their excuse is, well, we're not doing this to argue invalidity based

on those two patents because they have an anticipation defense based on Yonah, single reference with Yonah.

And we say, well, then you don't need the patents. You're just putting them in to mislead the jury. Then their response is, well -- at least it was until this morning. Well, it's constructive reduction to practice and we still object to it. And then they said, well, this is actual reduction to practice. The patents aren't actual reduction to practice. They can have a witness testify --

THE COURT: Well, hold on one minute. Is what they want to argue what the slide shows? I assume whatever's on the slide and whatever they told you the reason we want to have it in is because their expert is going to testify about that issue. Is what you are telling me -- and I'll hear from Intel, but was that in their report? In other words, I mean --

MR. CHU: I'm informed actual reduction to practice which is the current position was not in their report, and my recollection is he referred to these two patents.

He also had three prior art combinations and all kinds of other things. I believe these two patents were referred to in terms of constructive reduction to practice, but the main purpose has nothing to do with Yonah because they're going to bring in Yonah.

They're going to have lots of evidence and testimony about Yonah and they don't need those two patents. They want to

mislead the jury to think that Intel has found something inventive because Intel got two patents that relate to this area of technology. And we think it's completely irrelevant, and even if there is some relevance under 403, it ought to be excluded.

THE COURT: Understood.

Can I hear from Intel?

Yes, ma'am.

MS. SOOTER: Thank you, Your Honor. These two patents that we're currently talking about are part of the Yonah timeline. We are arguing that this Yonah product anticipates the '759 patent. VLSI is disputing the dates associated with Yonah.

These two patents are part of the Yonah development process. They do provide evidence that Yonah was developed prior to the priority date. If VLSI doesn't want to dispute that Yonah was a prior art product, then of course we wouldn't need the timeline including these patents, but these patents are part of that timeline.

THE COURT: Do the patents grow out -- were the patents part of -- did the patents grow out of something that the inventors did with respect to the development of the Yonah product?

MS. SOOTER: Yes, Your Honor. And there's a second reason too which I'd be happy to discuss if it would be helpful.

08:22 THE COURT: Mr. Chu, sounds to me like there's a basis for them to be putting those patents in.

08:22 MR. CHU: In that case, we won't contest the constructive reduction to practice. Patents are of course constructive reduction to practice.

08:22 THE COURT: I got it.

08:22 MR. CHU: So we won't contest it and the patents should be out.

08:22 THE COURT: Yes, ma'am.

08:22 MS. SOOTER: So two things, Your Honor. I would like to confirm that there's no dispute any longer that Yonah is a prior art --

08:22 THE COURT: Yes, ma'am.

08:22 MS. SOOTER: -- product.

08:22 And second of all, the other purpose for the patents is that we are making an anticipation argument under 35 USC 102(g) as a prior invention.

08:23 THE COURT: And is that in your expert's report?

08:23 MS. SOOTER: Absolutely, Your Honor. And part of 102(g), as Your Honor knows --

08:23 THE COURT: I'm good. Let me just hear from them. If it's in your report, I'd like to hear why it doesn't come in.

08:23 MR. CHU: I am advised that 102(g) evidence generally is okay as long as it doesn't involve these patents. And I'll consult with my colleagues on whether we would agree that it's

prior art, but because the patents were only for constructive reduction to practice, I am just saying now that we won't contest the constructive reduction to practice. There are a whole host of other issues potentially.

THE COURT: Well, I understand most of what you're saying, but I'm not sure what you're telling me with regard to the 102(g) issue. And it should frighten all of you that I actually know what 102(g) is, but I do.

So what I'm not sure I'm hearing you say is do you agree that it will -- is you're not objecting to it if it comes in -- are you telling me that it's not -- you're not objecting to it if it comes from 102(g)? And either of you can argue. I mean, I'm happy to hear from either.

MR. CHU: May I have just one moment?

THE COURT: Sure.

MS. SOOTER: I can clear up one thing as well, Your Honor.

MR. CHU: We don't contest 102(g). By that I mean we're not agreeing that it is, in fact, 102(g), but they shouldn't be disadvantaged by not having the patents for 102(g) purposes.

THE COURT: So you're not objecting to them coming in as long as it's for that purpose only?

MR. CHU: No, no. We are objecting to the patents coming in for any purpose.

THE COURT: Now I'm no longer following you.

MR. CHU: It's this training as the lawyer. Sometimes I'm

too careful, and it gets me in trouble at home. In this temporary home we're not contesting 102(g).

THE COURT: So does that mean you -- by not contesting 102(g), that means you are objecting to the patents or you're not?

MR. CHU: We are objecting to the patents. We're not objecting to their otherwise putting on evidence that it may be 102(g) and what would be fair game.

THE COURT: I'm sorry. So what you're saying is with respect to Yonah -- and is that Y-o-n-a?

MR. CHU: Y-o-n-a-h.

THE COURT: Okay. With respect to that product, you are not going to make an argument that it is not 102(g)?

MR. CHU: Correct. Let me see if I can --

THE COURT: I don't think you mean that because I think you are --

MR. CHU: That's right. In other words, we --

THE COURT: I think you are not agreeing that Yonah is 102(g). I feel certain of that.

MR. CHU: Correct. Correct. In other words, we are saying that Yonah under any statutory section in 102, it's not 102 anticipatory art. That's the main battle in terms of the substance.

THE COURT: But what Intel's telling me is that they told you in their report that they also are asserting -- they also

need to put these patents in to show that Yonah is 102(g) art and that that would substantiate that, and I'm not following why they wouldn't get to.

MR. CHU: But -- just a moment.

(Conference between counsel.)

THE COURT: Maybe I'm just not following the argument.

MR. CHU: Let me try it this way. We're not contesting that Yonah qualifies as prior art. That was the issue relating to the patents.

THE COURT: Well --

MR. CHU: It's prior art, but we're not saying that it anticipates.

THE COURT: I think it's true -- so you're not going to argue that it's not prior art. Your argument is that it does not -- that it is not sufficiently the same as to invalidate. So you're not going to say if it -- just for purposes of the argument, so I understand it, if this were a tricycle, you're not saying that it wasn't -- it's not also -- it wasn't reduced to practice. You're just saying that this tricycle does not invalidate the patents because it doesn't have all the elements and it's insufficient art and that's the only --

MR. CHU: Yes.

THE COURT: That's the only argument you're going to make?

MR. CHU: Yes.

THE COURT: Okay. Then tell me why the two Intel patents

would come in.

MS. SOOTER: Thank you, Your Honor. That is helpful to understand. There's a second reason.

THE COURT: Seems to me like you've won if you've got them down to -- sounds to me like they've eliminated every reason you need to have the Intel art in, but in a good way for you.

MS. SOOTER: That is helpful, Your Honor. I do agree. I just wanted to clarify that there's another requirement as Your Honor is well aware of 102(g), and the statute says that the prior invention was not abandoned, suppressed or concealed. And my understanding is that VLSI is arguing that we've abandoned, suppressed or concealed the invention, and these patents are obviously direct factual evidence that we have not done so.

THE COURT: I bet they're not going to anymore.

MR. CHU: That's correct, Your Honor, and I will not negotiate to buy a used car from Ms. Sooter in the future.

THE COURT: Okay. I'm going to exclude the Intel patents under that agreement, and if -- with the peril that if for some reason Intel believes that they do something on cross that opens the door where they are challenging something that would make the Intel patents relevant, we can revisit that.

But for right now, I understand what they're saying and I'll be listening to how they cross-examine the witness on that piece of prior art, and if you think that they have not lived

up to their agreement -- and I am not being pejorative, but, I mean, if you feel like they have said something that would invite you to be able to rely on the Intel patents, we'll take it up at that point.

MS. SOOTER: That sounds good.

Now, Dr. Conte did say that he was challenging it, that we did abandon this invention. So we will be able to cross him, I presume, and he will agree that he's not challenging that any longer.

THE COURT: You will be able to do that, yes.

MS. SOOTER: Thank you. And so, Your Honor, I just wanted to let you know, we did preserve our objection to the Intel patents on the later product, Speed Shift, as well. We wanted to perfect our record as you said on those as well. I understand there's a dispute.

THE COURT: Yes, sir.

MR. REDJAIAN: May I, Your Honor? Good morning. So Intel has a slide for Dr. Grunwald on Intel patents that practice -- or based on Speed Shift. And from your guidance yesterday, Your Honor said that they cannot -- Intel cannot refer to specific Intel patents.

THE COURT: Well, again, what I'm trying to avoid, big picture, is any inference being taken from the jury that because Intel has patents they can't infringe your patent because we know that's not correct. But that doesn't mean all

Intel patents are out. If there is a compelling reason for them to come in and they just -- if there's some compelling reason for a patent to come in and it happens to be an Intel patent, that's just the way it is. So I'm trying to balance those two things.

MR. REDJAIAN: May I show you the slide, Your Honor?

THE COURT: Sure.

MR. REDJAIAN: And so they want to put that to the jury and it's going to be confusing to them as to the purpose of those patents, and maybe they can just say they have a patent but not have a slide on it with patent numbers. It's just misleading and confusing.

THE COURT: I'm actually -- I'm with you on this one. This, I don't -- I think this slide, the way it's phrased, Intel Speed Shift patents, swerves into the idea that we've got patents too, and I -- and that's what I'm trying to avoid. But if during the examination we need to go over these patents as Mr. Lee pointed out on some of the other documents, they're going to see that the assignee is Intel, and Intel's not prohibited from it being an Intel patent. But I'm -- I will agree with you that I don't want this slide coming in as it's currently arranged.

MR. REDJAIAN: Okay. Thank you.

THE COURT: For the reason that it gives -- might give the impression that Intel has patents too, that does worry me a

little bit.

MR. REDJAIAN: Okay.

THE COURT: Generically, Intel has patents in this area as opposed to having a specific reason to discuss any one patent.

MS. SOOTER: If I could respond to that briefly, Your Honor.

THE COURT: Not on this. Not if you're asking to get this slide in.

MS. SOOTER: Fair enough, Your Honor.

I'll just reiterate that it's the same reasons that Mr. Lee argued yesterday. And they feed into the damages experts' Georgia-Pacific factor analysis.

THE COURT: Understood. And so we are -- if you all get ready, we're going to bring the jury in. I promised them we were going to start at 8:30.

MR. REDJAIAN: I'm sorry. There's one other big issue, Your Honor, as it relates to claim construction.

THE COURT: You've got about 30 seconds.

MR. REDJAIAN: They have a slide on -- that they're going to use to say that the meaning of the claim is different than the ordinary meaning, and Your Honor ruled --

THE COURT: Does that witness -- is that witness going on right now?

MR. REDJAIAN: No.

THE COURT: When is that witness going up?

MR. REDJAIAN: Third up.

THE COURT: Then we'll take it up at our break.

MR. REDJAIAN: Thank you, Your Honor.

THE COURT: We'll bring the jury in. We'll come back in in two minutes.

THE BAILIFF: All rise.

(Recess taken from 8:33 to 8:36.)

THE BAILIFF: All rise.

THE COURT: Please remain standing for the jury.

(The jury entered the courtroom at 8:36.)

THE COURT: You may be seated.

Mr. Mueller, who's your next witness?

MR. MUELLER: Your Honor, we call Efraim Rotem.

THE COURT: Okay.

(The witness was sworn.)

MR. MUELLER: Good morning, ladies and gentlemen.

DIRECT EXAMINATION

BY MR. MUELLER:

Q. Good morning, sir. Could you please introduce yourself to the jury?

A. Good morning. My name is Efraim Rotem. I'm a father of three and grandfather of three lovely granddaughters who live here in the U.S. I'm a computer engineer working for Intel.

Q. Sir, I want to ask you a little bit about your

educational background. Where did you go to college?

A. I went to the Technion in Israel.

Q. And what is the Technion?

A. The Technion is the lead university in Israel in the -- in technology.

Q. And what did you study in college?

A. Electrical engineering.

Q. And did you continue your studies after you earned your bachelor's degree?

A. Yes. I did my master's and my Ph.D.

Q. Now, you work at Intel today; is that right, sir?

A. That's right.

Q. For how long have you worked at Intel?

A. 26 years.

Q. And what is your current title at Intel?

A. I'm a lead power architect and an Intel fellow.

Q. Now, I'll represent to you that we heard yesterday from Jonathan Douglas who's also an Intel fellow, but fair to say that's a pretty big honor at Intel?

A. Yes. It is.

Q. Now, how did you come to be an Intel fellow yourself?

A. I guess a lasting contribution to Intel products and technology and impact on the industry and academia.

Q. Now, let me ask you about the responsibilities that you've held over the years as a lead power architect. Could

you please explain to the jury what that entailed?

A. I am a lead power architect. I'm responsible for the definition and the implementation of features in the products that deal with managing the power and performance. I've done it for the last 21 years of my career.

Q. So over two decades?

A. Yes.

Q. Now, which Intel processors have you worked on personally as the lead power architect?

A. I worked on the Yonah. I've worked on several other products in between, and recently I am working on the Lake family.

Q. Now, I'm not going to ask you about any specific patents, but do you have patents for your work at Intel?

A. Yes. I have 152 patents.

Q. 152?

A. Yes.

Q. Now, let me ask you about the Intel processors that you've worked on over the years. Do you have those in mind?

A. Yes.

Q. Do the processors that you have worked on have something called a clock in them?

A. Yes.

Q. And in the Intel processors, what is a clock?

A. A clock is a signal that goes through the chip and

set the pace for it, like a drum in a band. When you go in a slow pace, everybody goes slow. If you run faster, everybody goes faster. That's the pace of the whole chip.

Q. And are you familiar with the term "clock frequency"?

A. Yes.

Q. What does that mean in the context of the Intel processors?

A. Frequency's one of the measure by which you describe the properties. That means how many beats per second the clock goes.

Q. Why do the Intel processors use these clocks?

A. They use these clock to set the speed, to adjust the way that it work.

When you sit at your computer and doing something, sometimes you need to do more things. Sometimes you just stare at the screen and don't do anything. So by adjusting the clock, you can manage the power that the computer consumes versus the performance.

Q. Sir, are you familiar with the term "clock speed control" in the context of these processors?

A. Yes.

Q. What does it mean?

A. This is a mechanism of changing the clock and adjusting it to the requirements of the chip.

Q. Which Intel processors have used clock speed control?

08:41 A. All of them starting 1998.

08:41 Q. 1998?

08:41 A. Yes.

08:41 Q. Now, are you familiar with a term "SpeedStep" technology?

08:41 A. Yes.

08:41 Q. What is it?

08:41 A. SpeedStep is the original way of controlling a clock that was initiated in 1998.

08:41 Q. And why was this technology called SpeedStep?

08:41 A. Speed stands for the rate of the speed of the clock, and the step because it was changing in jumps, in intervals.

08:42 Q. Now, Dr. Rotem, I want to ask you about your work at Intel in the early 2000s period. Do you have that time period in mind?

08:42 A. Yes.

08:42 Q. So this is about 20 years or so ago. Have that in mind?

08:42 A. Yes.

08:42 Q. Now, are you familiar with a product, an Intel product called Yonah, Y-o-n-a-h?

08:42 A. Yes.

08:42 Q. What was it?

08:42 A. Yonah was the first dual-core processor that Intel introduced to the market.

08:42 Q. Now, what is a dual-core processor?

08:42 A. First core is the brain of the system. This is where everything happens. When you browse the Internet, when you shop on line, everything is running on the core. In dual core will have two brains.

08:42 Q. And Intel was -- I'm sorry -- Yonah was the first Intel product with two cores?

08:43 A. Yes.

08:43 Q. What was your personal role with respect to the Yonah processor?

08:43 A. I was the lead power architect.

08:43 Q. And what were your responsibilities as the lead power architect for Yonah?

08:43 A. I worked on the definition, the invention of the ideas and the implementation of these features in the product.

08:43 Q. Was there a marketing name for Yonah when it was sold in the public?

08:43 A. Yes. It was Intel Core Duo.

08:43 Q. And what types of computers was the Yonah chip used in?

08:43 A. It was used in client mobile products, the laptops and the notebooks that you're using in your daily life.

08:43 Q. When did Intel -- you and your colleagues at Intel start developing Yonah?

08:43 A. 2000 -- the early development started 2001. Most of

the people came 2002.

Q. For how long did Intel work on the design of the Yonah chip?

A. End to end, about four years. Most of the people work on it two years.

Q. I'm sorry. You said two years?

A. Two years.

Q. Sir, I think you have in front of you a plastic bag labeled DPX-3. It should be on the counter there.

A. No.

MR. MUELLER: Sir, may I approach? I actually have it here.

THE COURT: Of course.

MR. MUELLER: I apologize, Dr. Rotem. I'll just bring it over to you.

BY MR. MUELLER:

Q. Sir, do you know what DPX-3 is?

A. Yeah. This is Yonah.

Q. If you'd just hold that up for the jury. That's an actual Yonah chip?

A. This is how Yonah looks, yes.

Q. Now, I'm not sure -- I believe there's a copyright date on the bottom there. Can you see that?

A. Yes. It says 2004.

Q. 2004?

A. Yes.

Q. What is that Yonah processor that you're holding right there made out of?

A. This is the actual chip. And the material, this little square is made of silicon which is rock or sand.

Q. Let's take a look at Exhibit D-557. There's a paper copy in your binder, sir, or you can look at the screen, whatever's easier.

A. Yes.

Q. Do you recognize this document?

A. Yes.

Q. What is it?

A. This is a presentation given in 2005 about Yonah. It names Yonah, post silicon, post mortem.

Q. Now, what is that title "post silicon, post mortem" referring to?

A. So first, silicon is the material that the chip is made of. So post silicon, after silicon, means that we already had a product at hand.

And post mortem is learning, what we have done, studied, concluded and want to pass to the next generation or the next product to learn from.

Q. Lessons learned?

A. Yes.

Q. And what's the date on this presentation?

08:46 A. It is 2005.

08:46 Q. So by that point you already had a physical silicon chip?

08:46 A. For a while. Yes.

08:46 Q. Now, sir, if you could please turn to Page 9, and we'll put it on the screen as well.

08:46 What do we see here?

08:46 A. This is the number of people working on Yonah between 2002 and 2004. As I mentioned before, most of the people came in 2002 and the number of people -- we started with 120 people, and by end of 2004 there were 260 engineers.

08:46 Q. I'm sorry. 260 engineers as of 2004?

08:47 A. Yes.

08:47 Q. And over the years were there other folks -- let me withdraw the question.

08:47 Did the engineers change over time somewhat?

08:47 A. Yes. People come; people go. There are also other people in the support teams surrounded.

08:47 Q. But a total of hundreds of engineers worked on Yonah?

08:47 A. Hundreds of engineers.

08:47 Q. Now, where did those folks work geographically?

08:47 A. So as shown here, about half of them worked in Israel and half of them worked in Santa Clara, California.

08:47 Q. What types of work did those engineers do?

08:47 A. They did design work. They did validation work to

make sure that the product is functionally correct, functional correctly.

DA is the design automation. It is the tools that the engineers are working to build with it, various functions.

Q. Did any of those engineers work on clock control?

A. Yes.

Q. And where did the engineers who worked on clock control work?

A. Half of them in Israel, half of them in Santa Clara, California.

Q. When did Intel first manufacture these physical silicon Yonah chips?

A. In mid 2004.

Q. And where did that occur?

A. It occurred in Oregon in the U.S.

Q. Now, I'll represent to you that the jury's heard about these fabrication facilities that Intel has. Was this one of those?

A. Yes, this is one of them.

Q. And it was one that was located in Oregon. Do I have that right?

A. Oregon, yes.

Q. Now, could you please turn to Slide 14, and we'll put this on the screen here too. What do we see here?

A. What we see here is various versions, or stepping, of

the product. When we were first manufacturing, it is not perfect, so we work, we fix things and we do versions of it.

Q. Each step is a version?

A. Yes.

Q. Could you take a look at the center of the screen? There's an indication of B0. Do you see that?

A. Yes.

Q. What does that indicate, B0?

A. B0 is a revision, later revision. And then in this specific instance, B0 is the version. This is what we sold eventually.

Q. And do you see there's an indication, a green circle with "B0" up there at the top?

A. Yes.

Q. That's that B0 version?

A. Yes.

Q. What was the date on that?

A. This is April 2005.

Q. Now, what did Intel do with the manufactured Yonah processors in 2004?

A. With 2004 once it is stable enough, we ship it to our customers in order for them to build their systems.

Q. And when were they first supplied to customers? What month, if you recall?

A. Yeah. October 2004.

Q. Let me ask you to look at Exhibit D-294. It's in your binder, but we'll put it on the screen as well. Do you recognize this document, sir?

A. Yes.

Q. What is it?

A. This is a list coming from our finance team that lists all the units that we had shipped to our customers and the date of shipment.

Q. Let me ask you to look at Column T.

A. Yes.

Q. What do we see there?

A. It says Yonah 2, means that this is Yonah with a dual core.

Q. The 2 is the dual core?

A. Yes.

Q. And if we go over to Column A?

A. These are the dates.

Q. And what dates do we see for Yonah?

A. October 2004.

MR. MUELLER: We can take this down.

BY MR. MUELLER:

Q. Now, sir, can you give the jury some examples of some of the customers that Intel shipped these chips to in October of 2004, in that time period?

A. Yes. The customers are the one that build systems,

like Dell which is located here in Texas, like HP, Lenovo and so on.

Q. So now, Dr. Rotem, I'd like to focus on how this chip actually worked and some components within it. Do you have that subject in mind?

A. Yes.

Q. So let's start by -- if you could just hold up that physical chip one more time, that's the actual Yonah chip, right?

A. Yes.

MR. MUELLER: Now, let's put a photo of it on the monitors. Actually, let's take that down.

BY MR. MUELLER:

Q. If we were to look inside the chip, what would we see?

A. We will see a lot of squares and lines and connections and functional blocks.

Q. And so here, this is the outside of the chip. Do I have that right?

A. Yes.

Q. If we look at the bottom there, that's the copyright date of 2004?

A. Yes.

MR. MUELLER: Let's go to the next slide, please. This is DDX-8.2.

BY MR. MUELLER:

Q. What do we see here?

A. So this is an x-ray picture of the die, how it looks inside.

Q. That's if you look inside of it?

A. Yes.

Q. Now, sir, if you could, I'd like to build a bit of a diagram of these components inside that chip so you can explain them to jury, okay?

A. Okay.

Q. Okay. First, sir, I have a component, Core 1. What is that?

A. That's the brain of the computer. You can put it at the top left or right side.

Q. Next we have Core 2. What is that?

A. That's the other core. You can put it beside it.

Q. Now, we have a yellow sheet here labeled "bus." What is that?

A. Bus is the interconnect that connects the two cores and the rest of the world, and it goes just below the cores.

Q. That's used for communications?

A. Yes.

Q. Next we have something labeled "last-level cache," or "LLC." What is that?

A. This is the internal memory of the chip. You can put

it just below the bus.

Q. Now, for the bus, did it go by any other names within Intel?

A. Yes. BLS, which stands for bus subsystem -- bus logic subsystem.

Q. That's capital B, capital L, capital S?

A. Yes.

Q. Now, we've heard -- I'll represent to you that we've heard some testimony in this case about cache memories earlier in the case.

This last-level cache, is that an example of a cache memory?

A. Yes.

Q. Okay. So we've got some components here. I want to ask you how they work together, all right?

A. All right.

Q. Now, did Yonah run using a clock frequency?

A. Yes.

Q. So I have here a clock just to represent that clock, okay?

A. Yes.

Q. Where should I put the clock within this diagram of the Yonah chip?

A. Anywhere. We had one clock to serve them all. So wherever you put it is right.

08:55 Q. What exactly did that clock in Yonah do with respect to the other components that we see here?

08:55 A. It set the pace of the activity of the entire chip, the cores, the bus and the cache memory, like the drummer of the band.

08:55 Q. So they all ran at the same Speed?

08:55 A. Same speed.

08:55 Q. Let's take a look at Exhibit D-33. This is titled "Intel Multi-Core Architecture and Implementation."

08:55 Do you recognize this document?

08:55 A. Yes.

08:55 Q. What is it?

08:55 A. This is a presentation given by Ben Inkley from Intel, an application engineer, and it was given in the Intel Developers Forum.

08:55 Q. What is the Intel Developers Forum?

08:55 A. This is a big conference where Intel invites all our customers and users and engineers that build systems and we present them the core and have the opportunity to have direct interaction with them.

08:56 Q. Let's turn to the next page, if we could. And do you see there's a copyright date there towards the bottom?

08:56 A. Yes.

08:56 Q. What date is that?

08:56 A. 2005.

08:56 Q. What is the purpose of this document in the context of the Developers Forum?

08:56 A. It presents the product that we have built and are about to ship and explain the details of it to our -- the community of users.

08:56 Q. So the developers would develop programs that would work on the chip?

08:56 A. Yes.

08:56 Q. And you're explaining the chip to them?

08:56 A. Yes.

08:56 Q. Let's take a look at Slide 35.

08:56 What do we see here, sir?

08:56 A. This is a more detailed block diagram of the one that you have just built.

08:57 Q. So this block diagram, DDX-8.6, how does this compare to what we see in the document?

08:57 A. They are the same. This one is what you have just built.

08:57 Q. Let's take a look at Exhibit D-31.

08:57 Do you recognize this document?

08:57 A. Yes.

08:57 Q. What is it?

08:57 A. This is a presentation given by Barnes Cooper in 2003 about OSPM. OSPM means operating system power management.

08:57 Q. Who is Barnes Cooper?

08:57 A. He's an Intel fellow.
08:57 Q. And the date as we see here on the cover is what?
08:57 A. December 2003.
08:57 Q. Now, in this context what is an operating system?
08:57 A. Operating system is like the Window or the Mac OS. This is the software that is shipped with the computer and
08:57 operates the computer, the keyboard, the screen and everything
08:58 that happens there.
08:58 Q. And what is the relationship between this operating
08:58 system and the clock speed?
08:58 A. In this generation, the operating system, or more
08:58 specifically the OSPM, explicitly control the frequency of the
08:58 chip.
08:58 Q. Let's turn to Slide 5 in this document.
08:58 And this is labeled "P-State Controls." What do we see
08:58 here?
08:58 A. This is yet another step in the details of the block
08:58 diagram we have seen before, Yonah.
08:58 Q. So this is a more detailed version of this block
08:58 diagram?
08:58 A. Yes. It is.
08:58 Q. Where are the cores, these two cores, where are the
08:58 cores in this document? That is to say Exhibit D-31.
08:58 A. Yeah. This is one core, and this is the other core.
08:59 Q. Now, the title of this is "P-state Controls." What

does P-state controls refer to?

A. P stands for performance, and this is another name of frequency.

Q. Now, sir, using your touch screen, if you could please indicate for the jury how the operating system controlled the clock speed in Yonah, okay?

A. Yes.

Q. I'm just going to put this monitor here to follow along.

A. Okay. So as we've said, the core is the brains. It's where the operating system or the software is running on. So the operating system runs on one of the core -- any of the cores. And the OSPM tracks the utilization of the computer.

If you -- the user is using it heavily or you're less interactive with the system and it calculates what is called utilization.

Q. Can I just pause you right there?

So in real-life terms, if I'm using my computer for typing up a list of something, how does that relate to utilization?

A. So if you are typing, the utilization would be pretty low because between every stroke of a key there is, from computer perspective, there is a lot of free time, so the computer is halting and waiting for you to strike your keys.

Q. So what would be a real-life example of something that would involve heavy utilization?

09:00 A. If you are watching or creating video, if you are doing a Zoom interaction with your family and you're talking and watching your friends or family on the other side, this is a more heavy workload.

09:00 Q. Thank you, sir. Please continue.

09:00 A. So the OSPM tracks the utilization of the core. And based on the utilization, it makes an explicit decision what is the frequency that the computer needs to work on.

09:01 Then it sends an explicit request from the operating system to a control register, that is this described here, some internal structure that gets it. And from there it goes to a programmable clock controller.

09:01 The programmable clock controller gets this request from the operating system and has a lot of activities there and eventually generates the frequency and some other details of what the computer needs to work at.

09:01 Q. So where exactly -- show us one more time with the touch screen. Where is the request coming from?

09:01 A. It is coming from the core. Yeah. And continues here.

09:01 Q. And you've just drawn an arrow through -- from execution resources to PERF_CTL; is that right?

09:02 A. Yes.

09:02 Q. Now, how, if at all, did Intel use an operating system in testing this chip architecture that we see here?

09:02 A. It's fundamental. I mean, the computer has to have an operating system to work. You cannot turn it on without an operating system.

09:02 Q. And did those tests include testing of the clock control?

09:02 A. Definitely.

09:02 Q. When the Yonah silicon chips were shipped in 2004, were they configured for an operating system?

09:02 A. Yes.

09:02 Q. And when they were shipped in 2004, was the clock control enabled or disabled?

09:02 A. It was enabled.

09:02 Q. I'm going to ask you to look at Exhibit D-274.

09:02 Do you recognize this document, sir?

09:02 A. Yes.

09:02 Q. What is it?

09:02 A. This is a presentation given by two of my colleagues and myself about Yonah Power Management.

09:03 Q. You are the Efi Rotem on the cover; is that right?

09:03 A. Yes. I am.

09:03 Q. And the cover page here says, in the far right-hand corner, what date?

09:03 A. September 2003.

09:03 Q. What was the purpose of this document, sir?

09:03 A. This is a presentation that we, the architect, gave

to a team that's called system assurance, this is a validation team, about what we have designed into the chip so they will be able to test it.

Q. If you could please turn to Page 8 of this document.

This is labeled "P-state architecture." What does this page show us?

A. Basically it is the same chart that we have seen previously with the slightly more details for the engineers.

Q. Okay. Now, I want to direct your attention, if I could, Dr. Rotem, to the top of the page, where it says "single power plane, single frequency; single actual P-state for whole CPU."

Do you see that, sir?

A. Yes.

Q. What does that mean?

A. This is how Yonah worked. We had one clock, one P-state for all and the two cores and the bus were always changing together.

Q. Let's move back to the document camera for just one second here. And we had just the one clock for the Yonah clock control for these components, correct?

A. Correct.

Q. And how does that one clock relate to the document that we just saw?

A. This is exactly what is described in the document.

One clock, both cores, BUS and LLC are always changing together.

Q. And let's go back to the document for just one second here. And I'm referring to D-274.

And, sir, again the one clock is the same as the reference at the top of the page to the single power plane, single frequency?

A. Yes.

Q. Now, do you see at the top right corner it says "POR" in sort of a star there?

A. Yes.

Q. What's that referring to?

A. POR is plan of record, meaning this is actually what we have been through.

Q. How does the architecture in this slide, as well as DDX-8.6, compare to what was actually shipped in the Yonah chips in October of 2004?

A. This is what we built and this is what we shipped.

MR. MUELLER: We can take this down. Thank you.

THE BAILIFF: We have to power back up. The monitors went down again.

MR. MUELLER: Okay. So let me just do it one more time. So we're back at D-274. Can y'all see it now? No? We'll just hang on so the jury can see it too.

Your Honor, I think the jurors' monitors may not be

working. Maybe we just take a minute to try to fix it.

THE COURT: Sure. Of course.

MR. MUELLER: Oh, they're back up? Okay. Great. Terrific.

BY MR. MUELLER:

Q. So again, just to complete the thought here, DDX-8.6, we have a single clock, right?

A. Correct.

Q. Single frequency for all these components?

A. Correct.

Q. And then if we go back to D-274, we have the reference to a single power plane, single frequency, single actual P-state for the whole CPU?

A. Yes.

Q. And how does this architecture that we see in Exhibit D-274 and DDX-8.6 compare to what was actually shipped by Intel in October of 2004?

A. This is what we build, and this is what we shipped.

Q. Thank you, sir.

We can take down that document.

Now, I want to change gears and actually fast-forward in time about a decade. Okay?

A. Okay.

Q. Now, did you continue working on power architectures after you finished Yonah?

09:08 A. Yes. I've been the lead power architect for the entire time.

09:08 Q. Now, why not just stop with what you had with Yonah?

09:08 A. Because we were making more and more sophisticated and complex chips. They make progress, and they needed more and more sophisticated power management features.

09:08 Q. Now, you've worked at Intel for how many years? 26?

09:08 A. All together 26.

09:08 Q. And has Intel tried to keep innovating continually over that time period?

09:08 A. This is what we do for a living. We innovate all the time.

09:08 Q. Are you familiar with something called the Lake series processors which are named after some lakes?

09:08 A. Yes.

09:08 Q. How did those Lake series processors compare to Yonah?

09:09 A. Oh, it's totally different.

09:09 Yonah was a very simple structure, two cores. Bus connects them together, one clock, all of them changing together.

09:09 The Lake series was what we called the system on a chip. A single chip had four cores. It had a much complicated interconnect. It had graphics, video processing, total system.

09:09 Q. And when were these released?

09:09 A. The first one was released in 2015 and on.
09:09 Q. So it's over a decade after Yonah?
09:09 A. Yes.
09:09 Q. All right. Let me ask you to look at Exhibit D-36 and we'll put it on the screen here. Do you recognize this, sir?
09:09 A. Yes. I do.
09:09 Q. What is it?
09:09 A. This is my Ph.D. dissertation.
09:09 Q. And what was your Ph.D. dissertation about?
09:09 A. It is about power management. This is what I do.
09:10 Q. When did you complete your Ph.D.?
09:10 A. In 2014.
09:10 Q. Now, you've been working at Intel continually for over 25 years, right?
09:10 A. Yes.
09:10 Q. How did you manage to do a Ph.D. while working full time at Intel?
09:10 A. Well, my children grew up, left home, so it left me a lot of free time at the evenings or the weekends.
09:10 My wife and my eldest kid got their Ph.Ds so I needed to keep up with them. And most of all this is what motivate me, inspires me, give me a sense of purpose. This is what I like to do in my life, and this is how I bring value, a feel of bringing value to the community of the users.

Q. Let's turn to Page 2, and there's a summary of your dissertation here. Can you tell us just at a very high level, what is this about?

A. This dissertation is about managing power and energy of high performance computers.

Q. So I want to focus your attention, sir, on the middle of this summary on a sentence that starts: "Our novel H-EARtH algorithm is based on the observation that an intermediate frequency point is often more efficient and implements an optimal frequency calculation at runtime."

Do you see that, sir?

A. Yes.

Q. What is the H-EARtH algorithm?

A. H-EARtH algorithm is a sophistic algorithm that acknowledges the fact that the energy to performance relationship is a complex and interacted behavior, and it came with an innovative algorithm and idea how to best manage it.

Q. Who developed that algorithm?

A. I did.

Q. And it was part of the work in your dissertation?

A. Yes.

Q. And did you actually earn your Ph.D.?

A. Yes.

Q. Let's turn to Exhibit D-35. Do you recognize this document?

09:12 A. Yes.
09:12 Q. What is it?
09:12 A. This is a paper that I wrote together with my two advisors about the H-EARtH algorithm.
09:12 Q. And who is this paper for?
09:12 A. It was published in the IEEE. This is the engineering society, a well-distinguished paper, and it was intended for the engineering and the scientific community.
09:12 Q. So let's just set the stage here. IEEE stands for Institute of Electrical and Electronics Engineers. Do I have that right?
09:12 A. Yes.
09:12 Q. And what type of IEEE journal is this?
09:12 A. This is -- this is what is called a peer-reviewed engineer, meaning that when you submit a paper, a few top experts in the area read it, validate that it is indeed original, and it is -- brings value and progress and interest into the community, and once they accept it, they publish to the engineering community.
09:13 Q. So let me ask you to be a little bit immodest here. Is it a pretty big deal, pretty significant to be published in this journal, an article like this?
09:13 A. Yes. It is.
09:13 Q. Now, is your H-EARtH algorithm actually implemented in any Intel processors?

A. Yes. Once we develop the economic work, we took it and implemented in the Lake series.

Q. In the Lake series processors?

A. Yes.

Q. We've heard some references I'm going to represent to you in this trial to something called Speed Shift --

A. Yes.

Q. Not SpeedStep from a decade previous. Speed Shift. Do you know what that is?

A. Yes.

Q. What is it?

A. This is a marketing term of an umbrella of many sophisticated algorithm like the H-EARtH that autonomously manage and control the power and performance of the chip.

Q. How does your own algorithm, the H-EARtH algorithm relate to Speed Shift?

A. This is one of the algorithms that fit into this feature.

Q. What are some examples of other algorithms?

A. We have, for instance, an algorithm that we call "kick-down" for responsiveness.

Kick-down comes for the car, when you kick your pedal and the car races. So this is an algorithm that is intended to give the user a responsiveness.

There's another algorithm to balance the complex

interaction between the graphics and the core because you may -- if you do it wrong, it may happen that you give more power to the processor and the end result is less performance because the graphics didn't get enough.

So the balancing act is also another sophisticated algorithm there.

Q. How does the Speed Shift technology in the Lake series processors compare to the clock speed control technology in Yonah back in 2004?

A. Oh, it's totally different. The Yonah was a simple mechanism where the OS made an explicit decision, send us a request, and all that the chip was done -- did was honor the request and follow the explicit set point.

On the Lake family, this is totally autonomous. We don't get any request. We -- the sophis- -- algorithms observe what happens in the system, make an autonomous decision and control the P-state themselves.

Q. Let me show you PTX-1670. Do you recognize this document?

A. Yes.

Q. What is it?

A. This is a paper that was written by a few of my colleagues and myself included about the Lake family.

Q. Let's take a lack at Page 3. And there's a section here with the title "Power Management." Do you see that, sir?

09:16 A. Yes.

09:16 Q. Now, one of the things it says in that section is that "Skylake introduced a revolutionary approach to power management called Intel Speed Shift technology." Do you see that, sir?

09:16 A. Yes.

09:16 Q. And that's part of what you and your colleagues wrote?

09:16 A. Yes.

09:16 Q. What did you mean when you described your technology as revolutionary?

09:17 A. We mean that we don't wait for the offered assistance request and guidance anymore. We have sophisticated algorithms, mathematics and calculations to do the right thing and pick the right frequency based on these algorithms.

09:17 Q. You're proud of that work?

09:17 A. Yes. I am.

09:17 Q. What was your role -- your job position with respect to the Skylake processor?

09:17 A. I was the lead power architect.

09:17 Q. And that's the very first in the Lake series processors?

09:17 A. Yes.

09:17 Q. And you were the lead power architect?

09:17 A. Yes.

09:17 Q. About how many engineers worked on the Skylake processor?
09:17 A. Way over 1,000.
09:17 Q. When was it first launched?
09:17 A. In 2015.
09:17 Q. And for how long did you and all your colleagues work on Skylake before it was launched into the marketplace?
09:18 A. Around four years.
09:18 Q. Sitting -- actually, I think I have to bring it over to you.
09:18 MR. MUELLER: Your Honor, may I approach the witness?
09:18 THE COURT: Of course.
09:18 BY MR. MUELLER:
09:18 Q. I've handed you a plastic envelope labeled DPX-5. If you could, see if you can identify what's inside.
09:18 A. Yes.
09:18 Q. What is it?
09:18 A. This is actually Skylake.
09:18 Q. That's an actual Skylake chip?
09:18 A. Yes.
09:18 Q. Now, that looks to be smaller than the Yonah chip; is that right?
09:18 A. Yes. It is smaller in size.
09:19 Q. How do the number of components within the Skylake chip compare to the number of components in the earlier Yonah

chip?

A. It depends how you count. If you count by the smallest building blocks, it is 18 times more components in this one than the Yonah, and it has also many more functional blocks if you drove bigger boxes like the one you showed before.

Q. Now, if there's many more components in Skylake, how could it be smaller?

A. The process improved. The technology improved over time so we can squeeze more and more smartness and technology into smaller and smaller devices.

Q. So the wires are literally tinier?

A. Everything is tinier, the wires, the building blocks, everything.

Q. Let's take a look at an image and tell us what we see here. Let's go back -- I'm sorry. Go back to the previous one for a second. The cover. There we go. What do we see here, sir?

A. This is this chip.

Q. Just a blown-up version of what you're holding?

A. Yes.

Q. Now, if we crack this open, let's take a look at the next slide, what would we see?

A. So this is the x-ray picture of the actual product.

Q. Now, sir, I'd like to ask you about some of the

components inside this chip and how they work, okay?

A. Yes.

Q. Now, I'm going to represent to you that Jonathan Douglas took the stand yesterday and explained to the jury how the Haswell and Broadwell processors worked, okay? I'm just going to make that representation to you.

A. Okay.

Q. And I will further represent to you that we created something that looks just like this. This is a replica of what we created yesterday, and this is marked DDX-8.9.

So I want to take what Mr. Douglas -- what we put together with Mr. Douglas' help and ask you to make sure we have components in the right places for Skylake, okay?

A. Okay.

Q. Now, for starters, how many cores did Skylake have?

A. Four.

Q. And how did the cores in the Skylake processor communicate?

A. They communicated with a new structure that we call the ring.

Q. So I am holding up a yellow component labeled "Ring." What is the ring in the Skylake processor?

A. The ring is a sophisticated interconnect that communicates between the cores. It comes just below the cores.

Q. Right about there?

09:21 A. Yes.

09:22 Q. So let's just make sure we're on the same page.

09:22 Mr. Douglas was testifying about Broadwell and Haswell.

09:22 When were those released relative to the Lake series?

09:22 A. About seven years earlier than that.

09:22 Q. So the Lake series is after Broadwell and Haswell?

09:22 A. Yes.

09:22 Q. And the ring is new to the Lake series?

09:22 A. Yes.

09:22 Q. Now, was there a graphics block in Skylake?

09:22 A. Yes.

09:22 Q. And what was it used for?

09:22 A. Graphics is the block that draws the picture that you

09:22 see on your screen.

09:22 Q. There's a pink rectangle here labeled "PCU." Was

09:22 that in Skylake?

09:22 A. Yes.

09:22 Q. And, in fact, were these other components in Skylake?

09:22 A. Yes.

09:22 Q. What does PCU stand for?

09:22 A. It stands for package control unit.

09:22 Q. And what was the PCU's role with respect to clock

09:22 control?

09:22 A. The PCU is the unit that controls the clock.

09:23 Q. Okay. Now, you told us about how the clock control

worked in that older Yonah processor from over a decade earlier?

A. Yes.

Q. What controlled the clock speed in this architecture from the mid-2015 period?

A. The set of algorithms that I mentioned earlier were collecting -- observing the behavior of the chip by a means of telemetry, collecting data and information on regular basis, making -- running all the sophisticated algorithms, making decisions and controlling the clock.

Q. Did the cores use clock speed in the Skylake architecture?

A. Yes.

Q. So I have a component here to represent clock frequencies for the cores. Tell us precisely how that would work in the Skylake architecture.

A. Put them inside the cores because they control the cores only.

Q. Now, does the ring, this yellow component in the middle here, did that have a clock frequency in Skylake?

A. Yes. It has its own clock.

Q. So we have blue clocks for the core clock frequencies. Do you see that, sir?

A. Yes.

Q. And I have a yellow clock for the ring frequency.

Where should I put that?

A. Put it beside the ring because this is -- belongs to the ring.

Q. In the Skylake power architecture for which you were the lead power architect, did the ring and core share clock frequencies?

A. No. They are different.

Q. Different clocks?

A. Yes.

Q. Have different speeds?

A. Yes.

Q. Now, what about the graphics processor here? Did that also have a clock frequency?

A. Yes.

Q. So I have here an orange clock. Where should I put that?

A. By the graphics. It belongs to the graphics.

Q. Did the graphics share a clock frequency with the cores or the ring?

A. No. It was independent.

Q. Let's take a look at Exhibit D-254.

Do you recognize this document, sir?

A. Yes.

Q. What is it?

A. This is a presentation that I gave in Intel

Developers Forum about the Lake architecture.

Q. And what year was it given?

A. 2015.

Q. And you are the Efraim Rotem on the cover of this document; is that right, sir?

A. Yes.

Q. Let's turn to Page 6. This is titled "Skylake power Management ID Card." What do we see?

A. We see here what is called domains, which is groups of component that work together. So you see the cores having the purple color, which is one domain with one clock and voltage domain.

You see the ring, which is the red, having a different domain. And there is the graphics and other system components, which are a different domain as well.

Q. Now, how does this diagram that we see on this page relate to the block diagram that we put together?

A. This is --

Q. This is DDX-8.9, just to make sure the record is clear.

A. This is a more detailed version of that graph.

Q. Now, do you see where it says, towards the bottom, second to last bullet point, "Independent frequencies for ring, PG slice and logic"? Do you see that, sir?

A. Yes.

09:27 Q. What is that referring to?
09:27 A. That says exactly the same thing, that the cores, the ring and the PG graphics. And the graphics, each one of them have a separate clock, separate frequency.
09:27 Q. And how does that sentence on that page relate to the different colored clocks in DDX-8.9?
09:27 A. It is saying the same thing.
09:27 MR. MUELLER: We can take that document down. Thanks.
09:27 BY MR. MUELLER:
09:27 Q. Now, sir, you've used the word "autonomous" a few times in describing this Speed Shift clock control technology.
09:27 What does that mean in the context of these processors?
09:27 A. Autonomous is as opposed to the request from the operating system. In the old technology, the operating system in software made a frequency decision and sent -- for the programmable clock controller to set the frequency.
09:28 And autonomous means that we don't need request anymore. We have sophisticated algorithms that do the calculations and make an autonomous self-decision of the frequency.
09:28 Q. So let's just walk through this step by step, and I have back up DDX-8.9. And if you could use your touch screen, which component decides whether to shift the clock control?
09:28 A. The PCU.
09:28 Q. The PCU?
09:28 A. Yes.

09:28 Q. Now, what is the basis on which the PCU makes that decision?

09:28 A. It is based on what we call telemetry, data that we collect about a system.

09:28 Q. What exactly is telemetry data?

09:29 A. Telemetry stands for tele and metric, sensing from remote. That means that there is a data that is being collected by hardware counters and so on. It is being distributed on regular basis towards the PCU.

09:29 The PCU -- the hardware in the PCU gets all this. And whenever the PCU needs the piece of data, it looks at what's there and runs the algorithm and make the decision.

09:29 Q. Are you familiar in these processors with something called the C0 residency information?

09:29 A. Yes.

09:29 Q. What is it?

09:29 A. This is one of the metrics that is being transmitted on the -- in the system. C0 means active. There are different C-states, C0, 1, 2 and through 10. So zero means active and nonzero means the CPU is asleep.

09:30 Q. And, sir, could you just, using your finger on the touch screen, indicate where the C0 residency information comes from to get to the PCU?

09:30 A. It comes from a piece of hardware sitting aside the cores, not inside the core. Something that we call PMA, and it

is regularly being transmitted.

Q. What triggers those components to provide this C0 residency information to the PCU?

A. Nothing. It goes all the time, even when the cores are asleep.

Q. No request?

A. No request.

Q. Now, how does this system compare, the one in DDX-8.9 in the Lake series processors that were released starting in 2015? How does that compare on the one hand with the Yonah clock control from back in 2004, and that's DDX-8.6.

A. Totally different.

Q. And with respect to this autonomous process, which one was autonomous?

A. The Lake series.

Q. And that's DDX-8.9?

A. Yes.

Q. From 2015 and on?

A. Yes.

Q. Was the 2004 Yonah clock control system autonomous?

A. No.

Q. Now, you've referred to the clocks in the Skylake processor as independent, right?

A. Yes.

Q. And, in fact, we saw a document that used that same

term?

A. Yes.

Q. What does it mean for these clocks to be independent?

A. That they are different clocks and they are running at different frequencies. Usually the ring will run lower than the cores, slower than the cores. But sometimes if the graphics needs a lot of traffic, a lot of data, then the graphics will run faster and the ring will be -- run faster than the cores. So there is no relationships between the -- between them.

Q. And how does the independent clock control of the Skylake 2015 and on processors, and that's DDX-8.9, compare to the Yonah clock control of 2004?

A. Yonah had one for all, cores, bus, memory.

Q. One clock?

A. One clock. And the Skylake had multiple clocks. Each block running at a different frequency and a different clock.

MR. MUELLER: Your Honor, if we just turn off the public monitors for a document.

THE COURT: Yes, sir.

MR. MUELLER: We don't need to seal.

BY MR. MUELLER:

Q. Let's put up --

THE COURT: And you're okay if we continue to telecast it

though?

MR. MUELLER: I'm sorry, Your Honor?

THE COURT: You're okay if we continue to telecast?

MR. MUELLER: Yes. That's fine, Your Honor.

THE COURT: Very good.

BY MR. MUELLER:

Q. If we could go to Exhibit D-255.

Do you see, sir, this is a document entitled "Skylake HAS"?

A. Yes.

Q. And at a high level, what is this type of document describing?

A. HAS is a high level architectural specification. So this is a definition for the engineers how to build the system.

Q. Now, how are these document -- well, withdrawn.

Eventually your architectures need to get turned into actual circuits and code running on those circuits; is that right, sir?

A. Yes.

Q. And who does that at Intel?

A. Design engineers.

Q. And are you familiar with the term called "P-code"?

A. Yes.

Q. What is P-code?

A. P-code is one of the embedded software that runs on

09:33 the system. Not the Microsoft one, not the applications, the
09:34 browser, but Intel internal software that we write and run on
09:34 the software.
09:34 Q. And there's folks at Intel that write the P-code?
09:34 A. Yes.
09:34 Q. Are you familiar with a gentleman named Dan
09:34 Borkowski?
09:34 A. Yes.
09:34 Q. Is he an example of someone who actually writes
09:34 P-code?
09:34 A. Yes.
09:34 Q. And you give folks like that architecture documents
09:34 like this, they turn it into P-code?
09:34 A. Yes.
09:34 Q. Let's turn to Page 8. And at a high level, sir, what
09:34 is this showing us?
09:34 A. This shows the clock, the little clock that you
09:34 drawed here. This is the details. It shows the clocking
09:34 scheme or the clocks in the Lake family.
09:34 Q. And how does what we see here on this page relate to
09:34 DDX-8.9, our diagram of the clock control components?
09:34 A. So it shows two of these clocks, the ring and the
09:34 cores.
09:34 Q. The ring and a core clock?
09:35 A. Yes.

09:35 Q. Now, you used the term "PLL." What does that mean?

09:35 A. PLL stands for phase-locked loop. And this is a technique of generating clock in our systems.

09:35 Q. Now, why are there two separate circles for the core PLL and the CLR PLL?

09:35 A. They are separate. We generate two independent clocks.

09:35 Q. What is CLR referring to here?

09:35 A. CLR is the ring and the other circuits with the rings, so the last-level cache and so on.

09:35 Q. And do you see in the bottom right corner it says "ring clock distribution"? Do you see that, sir?

09:35 A. Yes.

09:35 Q. What's that referring to?

09:35 A. This is the clock that goes and activate the ring.

09:35 Q. That's the ring clock?

09:35 A. Yes.

09:35 Q. And then if we look at the top right, we see a core clock. Do you see that, sir?

09:36 A. Yes.

09:36 Q. That's one of the core clocks in our diagram; is that right, sir?

09:36 A. Yes.

09:36 Q. Now, at the top of the page here it says "SKL supports independent core ring LLC/CBO frequency and voltage."

And then it continues. Do you see that, sir?

A. Yes.

Q. What does that sentence refer to when it uses the word "independent"?

A. That means that you have two clocks, and they are independent of each other. They're generated separately.

Q. And again, what are the benefits of the independent clock control in these more modern processors?

A. You can better optimize the complex relationship between the different components.

MR. MUELLER: Your Honor, we can take this document down and, Your Honor, we can go back on the public monitors as well.

THE COURT: Okay.

BY MR. MUELLER:

Q. To shift a bit, sir, if I could. You have been a lead power architect at Intel for many years, correct?

A. Yes.

Q. What is the relationship, the basic relationship, between power and performance in the Intel processors?

A. It is a very complex relationship. Sometimes you get more performance by giving it more power. But sometimes, as I mentioned with the graphics example, you can give more power to the core and it will run faster, but it will take power for the graphics so the relationship will be the opposite.

This is my Ph.D. dissertation show the complex

relationship between power, energy and performance. And so it is a complicated relationship that need sophisticated and advanced algorithms, like what we developed in order to best manage.

Q. As a factual matter, do the Intel procedures move up or down with respect to power and performance in a 1:1 ratio?

A. No.

Q. Why not?

A. The relationship is complex. I'll give an example.

If you give more power to a core when you need graphics, then you will get less performance. In some portions of the range, if you give more power to the core or more energy to the core, you will get less performance. And sometimes it's the opposite.

MR. MUELLER: Let's put PTX-3525 on the screen.

BY MR. MUELLER:

Q. Do you recognize this document?

A. Yes.

Q. What is it?

A. This is a study that I've done about what is the optimal chip to build in terms of size.

MR. MUELLER: And just so the record is clear, I think I misspoke. It's actually PTX-3523 is the number.

BY MR. MUELLER:

Q. Let's turn to Page 2. And before we do, is this

about power management this paper?

A. No. It's about building system.

Q. It's not about power management?

A. No.

Q. Let's go to Page 2 and Section 2.2. And I want to focus on the sentence that says "architecture and design teams keep the discipline of adding IPC features that cost 1:1 ratio of power to IPC."

Do you see that, sir?

A. Yes.

Q. Does that mean, that sentence right there, there's a 1:1 ratio between power and speed?

A. No.

Q. What does it mean?

A. Well, IPC means instruction per cycle, which is the architecture behavior. The cycle means that for any frequency you divide it by the number of cycles, so it is the architectural behavior.

And what it says is that if you put more transistors, if you build a bigger chip, this bigger chip can achieve more performance than a small chip. So this is the relationship between the size of the physical chip and the performance you can get from it.

Q. So if someone suggested that sentence suggests there's a 1:1 ratio between power and performance as a factual

matter, is that correct or incorrect?

A. No.

Q. No, it's incorrect?

A. It's incorrect.

MR. MUELLER: We can take that down.

Let's put up DDX-8.4.

BY MR. MUELLER:

Q. And I just have a few final questions for you, sir.

We have here a timeline. And just to summarize what you've told us, you worked on the Yonah chip in the early 2000s with your colleagues at Intel; is that right, sir?

A. Yes.

Q. And it was actually first shipped in October of 2004?

A. Yes.

Q. Then if we fast-forward a decade, you're working on your thesis in 2014; is that right, sir?

A. Yes.

Q. And the Skylake chip was released in 2015; is that right?

A. Correct.

Q. Now, there were a number of other Lake series processors released after Skylake, correct?

A. Yes.

Q. Kaby Lake, Coffee Lake, Amber Lake, Whiskey Lake, Cannon Lake, Cascade Lake, Comet Lake, Ice Lake, Tiger Lake.

09:41 Do you see all those?
09:41 A. Yes.
09:41 Q. What was your personal role with respect to all those processors?
09:41 A. I was the lead power architect for this.
09:41 Q. You were the lead power architect for all of them?
09:41 A. All of them.
09:41 Q. Now, you explained to us in DDX-8.9 how clock control worked in the Skylake processor. Do you recall that, sir?
09:41 A. Yes.
09:41 Q. You told us about the autonomous control.
09:41 A. Yes.
09:41 Q. You told us about the independent clock frequency; is that right?
09:41 A. Yes.
09:41 Q. With respect to the architecture that you explained to the jury in DDX-8.9, how did that Skylake architecture
09:42 compare to the other Lake series processors that we see here?
09:42 A. The entire Lake family work the same way.
09:42 Q. Okay. Last few questions. Let me take the timeline down.
09:42 Sir, in your two decades or more at Intel have you made it a practice to read other companies' patents?
09:42 A. No.
09:42 Q. Why not?

09:42 A. It's not useful. I focus on my own inventions and innovations. We have problem to solve so we focused on these problems and we solve them in our own way.

09:42 Q. When you were working on your thesis and the Skylake architecture, had you heard of the '759 patent which is one of the two patents asserted in this case by VLSI?

09:42 A. No, I did not.

09:42 Q. And in fact, sir, in all of the years before this lawsuit was filed, had you heard one word about the '759 patent?

09:43 A. No, I had not.

09:43 Q. And had you heard of the '373 patent either?

09:43 A. No, I have not.

09:43 Q. Thank you, sir.

09:43 MR. MUELLER: I have no further questions.

09:43 THE COURT: Counsel?

09:43 MR. REDJAIAN: Your Honor, may we have ten minutes to set up?

09:43 THE COURT: Sure.

09:43 Ladies and gentlemen, we're going to take a recess for ten minutes. Remember my instructions not to discuss the case amongst yourselves.

09:43 Doctor, you may step down.

09:43 THE BAILIFF: All rise.

09:43 (Jury exited the courtroom at 9:43.)

09:43 1 THE COURT: I assume we have nothing to take up?
09:43 2 MR. MUELLER: No, Your Honor.
09:43 3 (Recess taken from 9:43 to 9:58.)
09:58 4 THE BAILIFF: All rise.
09:58 5 THE COURT: Please remain standing for the jury.
09:58 6 You all may be seated.
09:58 7 Counsel, you may proceed.
09:58 8 CROSS-EXAMINATION
09:58 9 BY MR. REDJAIAN:
09:58 10 Q. Good morning. My name is Babak Redjaian, counsel for
09:58 11 VLSI. Good morning, Dr. Rotem.
09:58 12 A. Good morning.
09:58 13 Q. Now, Yonah was an Intel processor, correct?
09:58 14 A. Yes.
09:58 15 Q. And you worked on the Yonah processor, correct?
09:58 16 A. Yes.
09:58 17 Q. And Yonah worked with a feature called SpeedStep?
09:59 18 A. Yes.
09:59 19 Q. You testified to it earlier this morning, correct?
09:59 20 A. Yes.
09:59 21 Q. And in the Yonah processor, it's the operating system
09:59 22 that is making speed changes, correct?
09:59 23 A. Yes.
09:59 24 Q. And the use of the operating system to make speed
09:59 25 changes was the old approach, correct?

09:59 A. Yes.
09:59 Q. And you're familiar with the Skylake -- well, strike that.
09:59 You're familiar with the Lake processors, correct?
09:59 A. Yes.
09:59 Q. You're an architect on the Lake processors, right?
09:59 A. Yes.
09:59 Q. And Skylake was released in 2015; is that correct?
09:59 A. Yes.
10:00 Q. And you're familiar with the term "Speed Shift," correct?
10:00 A. Yes.
10:00 Q. Okay. And just so the jury's not confused, Speed Shift is the new approach to speed change; is that correct?
10:00 A. Yes.
10:00 Q. And SpeedStep is the old approach to speed change?
10:00 A. Correct.
10:00 Q. And Speed Shift was first introduced in the Skylake processor in 2015; is that correct?
10:00 A. Yes.
10:00 MR. REDJAIAN: I'd like to pull up Exhibit PTX-1670-NAT, please.
10:00 BY MR. REDJAIAN:
10:00 Q. Do you have that up, Dr. Rotem?
10:00 A. Yes.

10:00 Q. Okay. And this is an IEEE paper that counsel for Intel showed you this morning?

10:01 A. Yes.

10:01 Q. Okay. And the title of it is "Inside 6th-Generation Intel Core: New Microarchitecture Code-Named Skylake"; is that correct?

10:01 A. Yes.

10:01 Q. And you're a co-author of this paper?

10:01 A. Yes.

10:01 Q. And this was published in the IEEE Computer Society?

10:01 A. Yes.

10:01 Q. In 2017?

10:01 A. Yes.

10:01 Q. Now, is that a reputable publication?

10:01 A. Yes. It is.

10:01 Q. Okay. And the audience of the publication are other engineers, academia and people in the industry; is that correct?

10:01 A. Yes.

10:01 Q. As a side question, were you aware -- well, are you familiar with VLSI's expert, Dr. Conte?

10:01 A. No. I'm not.

10:01 Q. Were you aware that he's the president of the IEEE Computer Society in 2015?

10:01 A. No.

10:01 Q. Now, let's go to Page 3 of this document, PTX-1670. There's a section that's titled "Power Management."

10:02 Do you see that?

10:02 A. Correct.

10:02 MR. REDJAIAN: If we can blow that up. Thank you.

10:02 BY MR. REDJAIAN:

10:02 Q. And the second -- well, let me backtrack.

10:02 You contributed to this portion of the paper, correct?

10:02 A. Yes.

10:02 Q. You contributed to the portion of the paper on power management?

10:02 A. Yes.

10:02 Q. Okay. And in there you say: "Skylake introduced a revolutionary approach to power management called Intel Speed Shift technology"; is that correct?

10:02 A. Correct.

10:02 Q. And that was true, correct?

10:02 A. Yes.

10:02 Q. And just again, Speed Shift is a new approach to speed changes, correct?

10:02 A. Yes.

10:02 Q. Okay.

10:03 MR. REDJAIAN: And if we can show the next sentence, please, Mr. Simmons.

10:03 BY MR. REDJAIAN:

10:03 Q. And the next sentence says: "Operating systems traditionally have been responsible for managing performance and energy by controlling the CPU voltage and frequency via P-states," correct?

10:03 A. Correct.

10:03 Q. And this is referring to the old approach?

10:03 A. Yes.

10:03 Q. This is referring to SpeedStep?

10:03 A. Yes.

10:03 Q. And this is referring to Yonah?

10:03 A. Yes.

10:03 Q. And the word "P-states," the last word in that sentence, means speed? Would that be accurate?

10:03 A. It's frequency.

10:03 Q. Frequency. Okay.

10:03 MR. REDJAIAN: Now, if we can go to the second column, please.

10:03 And thank you.

10:03 BY MR. REDJAIAN:

10:04 Q. At the top of Column 2 on Page 3, it says: "The OS" -- OS refers to operating system, correct?

10:04 A. Yes.

10:04 Q. And operating system is software?

10:04 A. Yes.

10:04 Q. An example is Microsoft Windows?

10:04 A. Yes.

10:04 Q. Okay. It says: "The OS, however, has two fundamental limitations when it comes to making those optimizations," correct?

10:04 A. Yes.

10:04 Q. And one of the fundamental limitations is, it says: "The processor utilization evaluation is performed over a few tens of milliseconds because anything faster than that would have been too intrusive." Is that correct?

10:04 A. For those optimizations, that is correct.

10:04 Q. Sure, and that's what you wrote?

10:04 A. Yes.

10:04 Q. And the second bullet says: "The OS has limited visibility of the workload's instantaneous runtime behavior and micro-architectural characteristics," correct?

10:05 A. Yes.

10:05 Q. And that's what you wrote in that paper?

10:05 A. Yes.

10:05 Q. And it's correct. You stand by it?

10:05 A. Yes. For those optimizations, yes.

10:05 MR. REDJAIAN: Now, if we can go to the next sentence at the bottom of Column 2 or not the bottom, maybe the middle, please.

10:05 BY MR. REDJAIAN:

10:05 Q. First sentence says: "With Intel Speed Shift

technology in Skylake, the CPU assumes full responsibility of power, performance and energy efficiency, not the OS." Correct?

A. This is a typo. It should have been "the PCU."

THE COURT: I'm sorry. I just couldn't understand your answer.

THE WITNESS: It is a typo. It is PCU, not CPU.

BY MR. REDJAIAN:

Q. Now, did you ever correct that typo in the paper?

A. No. I just noticed it.

Q. Okay. And that's true, correct? This statement is correct with the correction you're making?

A. Yes.

Q. Okay. And PCU stands for power control unit or package control unit?

A. Yes.

Q. Okay. And the PCU includes a controller, correct?

A. It includes a hardware controller.

Q. It includes a microcontroller, correct?

A. Yes.

Q. The Yonah processor, going back to the Yonah processor, did not have a controller, correct?

A. No. It's not correct.

Q. Okay. I'd like to read from your deposition.

Mr. REDJAIAN: Can we get Page 250, Line 6 through 9? Can

we have that video queued up, please?

MR. MUELLER: Your Honor, before it's played for the jury, if we could just have the witness see it and we could see it as well?

THE COURT: Sure.

MR. MUELLER: I'm sorry. Could you give me the transcript set one more time?

MR. REDJAIAN: Sure. It's 250, Lines 6 through 9.

THE COURT: And is your technical person bringing it up?

MR. REDJAIAN: Yes. Can you bring up the text, please?

MR. MUELLER: No objection to playing that, Your Honor.

MR. REDJAIAN: Okay. Actually can you play the video, please, Mr. Simmons? Thank you.

(Videotaped deposition played.)

Question: "It did not have a controller?

Answer: "It did not have a controller. It did not have hardware controller on it."

BY MR. REDJAIAN:

Q. And I'm going to read that again just for clarity of the record. The question was, "The Yonah processor did not have a controller?"

Answer: "It did not have a controller. It did not have a hardware controller on it."

Did I read that correctly?

A. Yeah, this is correct. This is exactly what I said.

10:08 Q. And that's what you said at your deposition?
10:08 A. Yes.
10:08 Q. And your deposition was on June 29th, 2020?
10:08 A. Yes. And I said it did not have a hardware controller. This is the same answer I gave right now. It did have a programmable clock.
10:08 Q. Excuse me, sir. That's okay. And you were under oath when you made that statement?
10:08 A. Yes.
10:08 Q. When you gave that testimony?
10:08 A. Yes.
10:08 Q. And you had the opportunity to correct your deposition transcript, correct?
10:09 A. The deposition is correct. No reason to fix it.
10:09 Q. And you didn't correct your transcript?
10:09 A. There is no reason to correct it.
10:09 Q. Thank you.
10:09 MR. REDJAIAN: Okay. Can we go to Exhibit PTX-1687-NAT, please?
10:09 BY MR. REDJAIAN:
10:09 Q. And have you seen this document before, Dr. Rotem?
10:09 A. Yes.
10:09 Q. Okay. And this is a document that you -- well, it's a document that's entitled "Power Management of the Sixth Generation Intel Core Processor: Code Name Skylake." Is that

10:09 correct?
10:09 A. Yes.
10:09 Q. And it's a -- you're an author of this paper?
10:10 A. Yes. It's an abstract. It's not a paper.
10:10 Q. It's an abstract, and you're -- well, you're an author of the abstract, and you're the first named author, correct?
10:10 A. Yes.
10:10 Q. Okay. And this was submitted to a Hot Chips 2016 Conference, correct?
10:10 A. Yes.
10:10 Q. And the audience for the Hot Chips 2016 Conference are people from industry; is that right?
10:10 A. Yes.
10:10 Q. And that's a public conference?
10:10 A. Yes.
10:10 MR. REDJAIAN: And let's go to Page 2, please, Mr. Simmons.
10:10 BY MR. REDJAIAN:
10:10 Q. And the second paragraph, I'm reading it. It says: "Skylake introduced a revolutionary approach to power management called Intel Speed Shift Technology."
10:10 Did I read that correctly?
10:10 A. Yes.
10:10 Q. Okay. And next sentence says: "After two decades of

10:11 OS power and performance control, the power management firmware and hardware of Skylake assumed full responsibility of power, performance and energy efficiency." Correct?

A. Yes. This is our technology.

Q. Sure. Understood. Thank you.

And the OS that's mentioned in that sentence is operating system?

A. Yes.

Q. Okay. And the next sentence says: "A full, autonomous control algorithm replaces the operating system P-state selection and achieves up to 15 percent improvement in performance and energy efficiency of lead benchmarks user visible scenarios"; is that correct?

A. Yes.

Q. And the next sentence you mentioned, it says: "Win 10." Is that referring to Windows 10?

A. Yes.

Q. Okay. And Win 10 and other lead OS fully migrated to the new hardware P-state control; is that correct?

A. Yes.

Q. And so this is saying that the lead operating system makers that are put in computers are compatible with Speed Shift, correct?

A. Yes.

Q. And they turn on Speed Shift, correct?

10:12 A. No.

10:12 Q. Okay. Now, let's turn to Page 3 if we could. And you have some test results or measured results. Do you see that at the bottom?

10:12 A. Yes.

10:12 Q. And those are tests that your team conducted?

10:12 A. Yes.

10:12 Q. Okay. And I'm going to read from there. It says: "User interactive work and some of the modern benchmarks such as WebX, TouchX, et cetera, care about short duration of work. Identifying the burst of work and returning to low frequency after completion both improve performance up to 30 percent and save energy up to 25 percent at the same workload," correct?

10:13 A. Yes.

10:13 MR. REDJAIAN: You can take that down, Mr. Simmons. Thank you.

10:13 BY MR. REDJAIAN:

10:13 Q. Now, you have worked with Intel's customers in connection with Speed Shift, correct?

10:13 A. Yes.

10:13 Q. Okay. And Intel's customers turn on Speed Shift in their computers, correct?

10:13 A. No.

10:13 Q. Well, let me backtrack. Intel's customers include computer makers such as Dell, HP, and so on, correct?

10:14 A. Yes.

10:14 Q. Okay. And Microsoft is also a customer because they make a product, correct?

10:14 A. Not exactly a customer.

10:14 Q. Okay. Well, you've met with Microsoft and Apple in connection with Speed Shift, correct?

10:14 A. Yes.

10:14 Q. Okay. And in some products, that you're aware of, the Surface team within Microsoft enables Speed Shift, correct?

10:14 A. They make use of it.

10:14 Q. So the answer is yes?

10:14 A. It is enabled when we ship it.

10:14 Q. And Surface is a computer that Microsoft provides?

10:15 A. Yes.

10:15 Q. And computers sold by Dell that have a Lake processor turn on Speed Shift, correct?

10:15 A. No.

10:15 Q. Well --

10:15 A. It is turned on out of the box.

10:15 Q. You know that on some systems that Dell -- well, Dell ships, Speed Shift is turned on?

10:15 A. Yes.

10:15 Q. Okay. And computers that HP ship, Speed Shift is turned on?

10:15 A. Yes.

10:15 Q. Okay. And you yourself have a Dell computer, correct?

10:15 A. Yes.

10:15 Q. And that has a Lake processor in it?

10:15 A. Yes.

10:15 Q. Yeah. And that in fact has Speed Shift turned on?

10:15 A. Yes.

10:15 Q. I'm going to change topics, Dr. Rotem.

10:16 MR. REDJAIAN: If we can pull up your thesis, D-36, please.

10:16 BY MR. REDJAIAN:

10:16 Q. And if -- and D-36 is a thesis that -- your thesis, Ph.D. thesis; is that correct?

10:16 A. Yes.

10:16 Q. Okay.

10:16 MR. REDJAIAN: And if we can go to Page 90.

10:16 BY MR. REDJAIAN:

10:16 Q. And Page 90 shows Chapter 5, the "EARtH-Energy Aware Race to Halt" algorithm; is that correct?

10:16 A. Yes.

10:16 Q. Okay.

10:16 MR. REDJAIAN: And let's move to Page 100. And the third paragraph, if you can blow that up. Down to -- a little bit farther down.

10:17 That's good. Thank you.

10:17 BY MR. REDJAIAN:

Q. And in your thesis, you're talking about the H-EARtH algorithm; is that right?

A. Yes.

Q. And I'm going to read a few sentence -- starting from a few sentences down, it says, "At runtime the H-EARtH algorithm is executed once every time interval and calculates the CPR and SCA."

Next sentence, "In our study, we evaluated these parameters every one millisecond and performed voltage and frequency decisions every ten milliseconds."

Do you see that?

A. Yes.

Q. And this is the algorithm that you implemented in the Lake processors?

A. Later on. Not in this thesis work.

Q. Okay. Later on you implemented the H-EARtH algorithm in the Lake processors?

A. Yes.

Q. And it was implemented in the PCU of the Lake processors?

A. Yes.

Q. Now, Intel's expert is not relying on your thesis as a defense to noninfringement, correct?

MR. MUELLER: Your Honor, I object. It's expert

testimony. It's not something that Dr. Rotem is here for or will be here for.

MR. REDJAIAN: Well, I just want to know if he's aware.

THE COURT: He can ask him if he's aware.

BY MR. REDJAIAN:

Q. Are you aware?

A. No. I'm not aware.

Q. Are you aware that developing a product on your own is not a defense to infringement? Correct?

A. I'm not an expert on legal matters.

Q. Now, if Intel infringes the '759 patent -- let me backtrack. If an Intel product infringes the '759 patent, it is not relevant whether the product also uses something described in your thesis, correct?

A. I have no legal way of providing that. I'm not an expert on legal.

Q. You're not a providing an opinion on that?

A. No.

Q. And infringement is determined by comparing an accused product -- well, let me strike that.

You're aware that infringement is determined by comparing an accused product to the claims of the '759 patent, correct?

MR. MUELLER: I have two objections. Number one, it's for Your Honor to instruct the jury on the law and not the witness; number two, if VLSI's counsel wants to inquire about the patent

and how it compares to the products, I think that'd open the door for the witness to compare the patent to the actual products.

MR. REDJAIAN: I'm not comparing them. I just want to know if he's aware of it, and he's saying he's not aware of it. That's all I'm establishing. I'm not going to go into any further detail.

THE COURT: Is this gentleman aware of the patent?

MR. MUELLER: He's read it since the lawsuit was filed, and he's prepared to compare it to the products, if permitted.

MR. REDJAIAN: He has no opinions or no report on the concept, Your Honor. I'm just talking about his thesis.

THE COURT: I'll sustain the objection.

MR. REDJAIAN: Thank you, Your Honor.

Now, let's pull up PTX-2371.

BY MR. REDJAIAN:

Q. And are you familiar with Exhibit PTX-2371?

A. Yes.

Q. This is a paper that you and others at Intel coauthored?

A. No. I coauthored it, but the other are not from Intel.

Q. I'm sorry. I couldn't hear you.

A. Sorry. The others are not from Intel. This is my -- about my dissertation and my academic work.

10:21 Q. And the other folks that are listed are not Intel employees?

10:21 A. No. They're my adviser in the -- in my dissertation.

10:21 Q. And the title is "Energy Aware Race to Halt: A Down to EARtH Approach for Platform Energy Management"; is that correct?

10:21 A. Yes. This is about my dissertation, my Ph.D.

10:21 Q. And this was published in 2012?

10:21 MR. REDJAIAN: Can we blow that up and go to the bottom?

BY THE WITNESS:

10:22 A. Yes. 2012.

BY MR. REDJAIAN:

10:22 Q. Okay. Now, earlier this morning when Intel's counsel asked you some questions, I wrote some notes. And you had mentioned that there are hardware counters in the Lake processors; is that correct?

10:22 A. Yes.

10:22 Q. And the hardware counters are located in the PCU; is that correct?

10:22 A. They are distributed all over.

10:22 Q. Including the PCU?

10:22 A. Some in the PCU.

10:23 MR. REDJAIAN: And let's pull up Exhibit D-274, please.

BY MR. REDJAIAN:

10:23 Q. And this is a paper that you talked about this

10:23 morning?

A. Yes.

Q. Okay. And you're one of the authors?

A. Yes.

Q. And this refers to the Yonah processor?

A. Yes.

Q. So now I'm going back to Yonah, just so we're orienting the jury here.

MR. REDJAIAN: If we can go to Page 5, please.

BY MR. REDJAIAN:

Q. And this is a slide that says "ACPI Power Management P-states." Do you see that?

A. Yes.

Q. And three bullets down, it says "P-state policy." Do you see that?

A. Yes.

Q. And under it a few lines it says, "Switch: on demand (currently 300-1,000 ms rate)"; is that correct?

A. That's what it says. This is not representing the rate -- the real rate.

Q. Is this representing the rate at which speed changes are made?

A. No.

Q. Okay. I'd like to switch topics, Dr. Rotem.

And earlier your counsel asked about reading other

companies' patents. Do you remember that?

A. Yes.

Q. And you're aware that patents are public, correct?

A. Yes.

Q. Okay. And your practice is not to read other companies' patents, correct?

A. Yes.

Q. In fact, you're discouraged from reading other companies' patents, correct?

A. No.

Q. Well, I'd like -- well, let me backtrack.

You look at publications from Intel's competitors, correct?

A. Yes.

Q. Okay. And your opinion is that you're not discouraged from reading other people's patents?

A. I'm encouraged to focus on the things that I do best, which is invent and innovate and not spend my time on things that I'm not an expert on.

Q. And that includes reading publications of your competitors?

A. No. Publications is more meaningful. The way that we compete in the market is that we try to play our best and do the best products. And so this is way the market works.

Q. Sir, you're in fact discouraged not to look at other

10:26 people's patents?
10:26 A. Sorry. Could you repeat that?
10:26 Q. You're discouraged from looking at other people's patents, correct?
10:26 A. No. Not explicitly.
10:26 Q. Okay.
10:26 MR. REDJAIAN: If we can pull up PTX-54, please. And let's go to Page 2.
10:26 BY MR. REDJAIAN:
10:26 Q. Now, you have looked at Intel's website in the past, correct?
10:26 A. Not specifically this website. I've looked at websites.
10:27 Q. And Intel has a public-facing website where they advertise their processors, correct?
10:27 A. Yes.
10:27 Q. Okay. And this is one example of Intel's public-facing website?
10:27 A. No. This is a VLSI document that printed a certain -- the choice of editor. You printed a certain piece of it.
10:27 Q. Well, so let's go at the bottom of that page, the HTTP. Do you see that at the bottom?
10:27 A. Yes.
10:27 Q. And this document comes from an Intel website,

10:27 correct?

A. It is printed out of Intel website. One out of thousands of pages. Yes.

Q. Okay. And this particular specification is for the Intel Xeon Platinum 8180 processor; is that correct?

A. That's what I'm reading.

Q. Do you have any reason to believe it's not correct, yes or no?

A. No.

Q. And the 8180 Processor, it says, was launched in Q3 2017?

A. Yes.

Q. And the recommended customer price for this single processor is $10,000; is that correct?

A. That's what it says.

MR. REDJAIAN: And if we can go to Page 4 of this document, please.

BY MR. REDJAIAN:

Q. At the top it says "Advanced Technologies." Do you see that?

A. Yes.

Q. Okay.

MR. REDJAIAN: And -- well, let's blow that -- let's -- you don't need to blow that up. Thank you. Just so I can see the entire page.

BY MR. REDJAIAN:

Q. Now, under Advanced Technologies, the first feature that's listed that says "yes" on the right is Intel Speed Shift Technology, correct?

A. The $20 part also have it. Yes.

Q. That wasn't my question, sir. The first feature under Advanced Technologies that is included in the Skylake server processor is listed Intel Speed Shift Technology, correct?

A. Yes.

Q. Thank you.

Now, if you click on the website -- and I've done this. So I'd have to admit I'm not sure if you have, but if you click on that Intel Speed Shift technology, you get a blow-up window. Have you seen that?

A. No.

Q. Well, I took your deposition last year, didn't I, sir?

A. I don't remember.

Q. Okay. Well, we were on Zoom so it was difficult. So I understand. But I believe you were shown the blow-up screen of when you click on that, what is shown. Do you seem to recall that?

A. I take your word for it.

Q. I understand it was a awhile ago.

10:30 MR. REDJAIAN: Let's go to Page 1 and see if we can blow up that middle part. I'm not sure if we can see it. Oh, well, that's not good. No.

10:30 I'm going to read it and we'll try to get a better copy.

10:30 BY MR. REDJAIAN:

10:30 Q. But it says, "Intel Speed Shift technology uses hardware controlled P-states to deliver dramatically quicker responsiveness with single-threaded transient (short duration) workloads, such as web browsing, by allowing the processor to more quickly select its best operating frequency and voltage for optimal performance and power efficiency."

10:30 Do you recall seeing that text?

10:31 A. Yeah. I believe this is the kick-down algorithm that we talked about earlier.

10:31 Q. And, Dr. Rotem, I'm sorry. I'm having a hard time hearing you. If you can speak into the microphone.

10:31 A. Sorry. I think this refers to the kick-down algorithm we talked about earlier.

10:31 Q. I want to go back to one question, Dr. Rotem, about being discouraged at looking at other companies' patents. So you said "not explicitly," correct?

10:31 A. Correct.

10:31 Q. Okay. Well, take a look at your deposition PTX-3408. Do you have that? It might be in your binder.

10:31 MR. REDJAIAN: And, counsel, it's Lines 247, 17 through

10:32 19.
BY THE WITNESS:
A. Say again the number.
BY MR. REDJAIAN:
Q. PTX-3408, Page 245, 17 through 19.
A. PTX-2...
Q. PTX-3408. We have it on the screen as well, if it might be easier.
A. Okay.
Q. Sorry about that.
MR. REDJAIAN: And you can remove the objections and just show 17 through 19, Mr. Simmons, please.
MR. MUELLER: My apologies. Can you just read that page one more time? 247, Line.
MR. REDJAIAN: Sure. 245, 17 through 19 and 246, 2 through 3.
BY MR. REDJAIAN:
Q. Question: --
MR. MUELLER: I just have -- I have no objection to this being shown to the jury. I would just ask that the full answer be shown to the jury.
THE COURT: Of course.
MR. REDJAIAN: Sure. I'm sorry, yes. So let's do that.
BY MR. REDJAIAN:
Q. Question: "Does Intel take steps to ensure its

employees avoid infringing others' patents?"

Answer: "We innovate, we invent our own technologies. We develop our products. We face issues and we address them to the best of our knowledge. And we are not examining other products or technologies, patents or -- we are discouraged not to look at patents. I personally don't look at patents."

That was your answer, correct?

A. Yes.

Q. Thank you.

MR. REDJAIAN: Take that down.

Can you give me a moment, please, Your Honor?

THE COURT: Sure.

(Conference between counsel.)

BY MR. REDJAIAN:

Q. Okay. Thank you very much, Dr. Rotem. I appreciate your time.

MR. REDJAIAN: That's all I have.

THE WITNESS: Thank you.

REDIRECT EXAMINATION

BY MR. MUELLER:

Q. Dr. Rotem, just a --

(Clarification by the reporter.)

BY MR. MUELLER:

Q. Just a few final questions here. I first want to pull up PTX-54.4, which is a document you were shown just now.

10:36 And, sir, do you see you were shown this list of advanced technologies and a particular Intel processor? Do you see that, sir?

A. Yes.

Q. Now, there's of course a long list of advanced technologies, right?

A. Yes.

Q. Speed Shift is one of them?

A. Yes.

Q. And counsel elicited some testimony that -- or noted that the cover had a price -- I'm not going to read it again -- for this particular chip, a recommended price. Do you recall that?

A. Yes.

Q. Was Speed Shift in other chips that were also sold by Intel?

A. All of them, including the entry-level lowest-priced product.

Q. And when you say "all of them," you're referring to the Lake series processors?

A. All the Lake series.

Q. And were there some lower prices for some of the Lake series processors?

A. Yes. Definitely.

Q. Can you give an example of the ballpark price for a

lower price?

A. In the 20, $30 range also. Enabled.

Q. Now, this says Intel Speed Shift technology; is that right?

A. Yes.

Q. These are Intel advanced features on this list?

A. Yes. These are the technologies that we invented, we developed. These are the kind of -- me and my colleagues have been working on for these years.

Q. Let me show you another document that you were shown on cross-examination. This is PTX-1687.

And you were asked about a part of this document that refers to certain power performance ratios?

MR. MUELLER: If we could pull up that section.

BY MR. MUELLER:

Q. Now, this paragraph right here towards the bottom, do you see where it says "user interactive work and some of the modern benchmarks," it starts that way?

A. Yes.

Q. I want to focus your attention on a sentence that you weren't shown, the very last one. "Active power management (Figure 3) demonstrate meeting the 1:2 and 1:3 power to performance ratio defined by the user in this study."

What is that referring to?

A. The user set some policy of a choice how he wants to

balance and performance. And the advanced algorithms that we have defined make the choice of power-performance based on these sophisticated algorithms to meet policy or a choice.

Q. And again, as a factual matter in the Intel chips, does power and performance march lockstep one to one?

A. No. Definitely not.

Q. Now, let me ask you a few final questions about the two sets of products that we discussed today. First, I want to start with the older Yonah processor. Do you have that in mind?

A. Yes.

Q. So I put up DDX-8.6. This is the clock control architecture for Yonah?

A. Yes.

Q. And again, just briefly summarize for us one more time how clock control worked in Yonah, very briefly.

A. In Yonah, the operating system ran on the core, looked at the utilization, make an explicit decision what is the frequency that he wants. It sends an explicit request to our programmable clock controller, and the programmable clock controller in Yonah moved the frequency for all components together, core, bus and LLC.

Q. One clock, one frequency?

A. One clock with an explicit request.

Q. Now, you -- a video clip of a portion of your

deposition was played during cross-examination.

MR. MUELLER: And if I could ask VLSI's counsel just to -- if you wouldn't mind, just play that video clip one more time.

BY MR. MUELLER:

Q. I want to ask you about the testimony that you were asked about.

MR. REDJAIAN: Objection, Your Honor. He can ask him the question. What question does he want to ask him?

MR. MUELLER: I want to show him the deposition testimony that he was asked about and then show a bit further in that same page. So just to orient the witness, I'd like to replay the --

MR. REDJAIAN: Well, you can just use that, Counsel.

THE COURT: I think I get to make this decision.

And so under the rule of optional completeness, one of you needs to put up the entire page, and he's free to show the jury any part of the testimony that he wants to.

How you all accomplish that is up to you all. But he certainly can -- you certainly can show the jury any other part of the deposition you want to.

MR. MUELLER: Thank you, Your Honor.

So let's put up Page 250, the entirety.

MR. REDJAIAN: Counsel, can you wait one second, please? Give me a second?

MR. MUELLER: Sure.

10:41 MR. REDJAIAN: Thank you.

10:41 MR. MUELLER: It's Page 250. We can take it down before -- let counsel have a look. Okay. Page 250.

10:41 BY MR. MUELLER:

10:42 Q. Now, the video clip was from Lines 6 through 9.

10:42 MR. MUELLER: Can we blow those up? Could you please play the clip at this point?

10:42 (Video played:

10:42 Q. The Yonah processor did not have a controller?

10:43 A. It did not have a controller. It did not have hardware controller on it.

10:43 BY MR. MUELLER:

10:43 Q. Do you stand by that today?

10:43 A. Yes.

10:43 Q. Was that a true statement?

10:43 A. Yes. Bear in mind there are two types of controllers. There is the programmable clock controller that is in Yonah, and there is the hardware controller in the Lake family.

10:43 When I was asked in the context, I initially thought -- the context was how the controller, the computer within the computer in the Lake family. So then I make an emphasis, saying it was not a hardware controller, meaning Yonah had a programmable clock controller, the other type. And the Lake family had the hardware controller.

10:43 Q. Now, this is the Lake architecture. I'm holding DDX-8.9; is that right? Do you see that, sir?

10:43 A. Yes.

10:43 Q. Where is the hardware controller that you're referring to here?

10:44 A. The PCU is the hardware controller.

10:44 Q. That pink rectangle?

10:44 A. Yes.

10:44 Q. Did Yonah have a PCU?

10:44 A. No.

10:44 Q. Is that what you're saying in your deposition?

10:44 A. That's what I'm saying.

10:44 Q. Now, let's go back to your deposition, the very same page.

10:44 And I want to go down to the bottom, the question that starts at the bottom there.

10:44 Question: "And the Yonah processor didn't have" -- no. I'm sorry. The one that starts at Line 25.

10:44 "And the Yonah processor didn't have" -- and it carries over -- "a programmable clock controller circuit, right?"

10:44 Answer: "The Yonah processor had an interface with motherboard-embedded controller that performed some of the function that we have discussed under the big umbrella of -- of HWP, even though it's one of them, the balancer type, the power management type."

10:45 What were you describing in that section of your deposition?

10:45 A. Actually, it starts one line above, the ASL code. I'm describing the programmable clock controller in Yonah, and mentioning that it had an embedded software in it.

10:45 Q. And you did that just a few lines later in that same page?

10:45 A. Yes.

10:45 Q. Last few questions, sir. You were asked about Intel -- I'm sorry. Your own approach to not reading other companies' patents. Do you recall that?

10:45 A. Yes.

10:45 Q. Now, you understand there's quite a few patents out there in the world?

10:45 A. Yes.

10:45 Q. Why don't you read other companies' patents?

10:45 A. I focus on my invention and my innovation. There's no point -- when you face a new problem, there is no point in looking at technology that someone solved ten years ago and assume that it will bring anything valuable for you.

10:46 We look forward. We have a problem. We need to execute fast. There's a lot of work to do. So we focus on the problem, innovate, invent things like the Speed Shift technology and the complex algorithms.

10:46 Q. Now, when was the first time you heard of the '759

10:46 patent that VLSI's asserting in this case?
10:46 A. In the context of this litigation.
10:46 Q. Now, I'm not going to ask you to compare the patent
10:46 to your products. That's for the experts. But had you heard
10:46 of that patent before this lawsuit?
10:46 A. No.
10:46 Q. Your Yonah processor from 2004, who came up with the
10:46 ideas in Yonah?
10:46 A. We did.
10:46 Q. Your Speed Shift technology in the Lake series
10:46 processors from 2015 and on, who came up with those ideas?
10:46 A. We did. I and my colleagues.
10:46 Q. Thank you, sir.
10:47 MR. MUELLER: I have no further questions.
10:47 MR. REDJAIAN: Just a few follow-up questions.
10:47 Let's pull up the transcript again, please. Page 250,
10:47 Mr. Simmons.
10:47 And let's go to Line 1 through 5. Can you blow that up,
10:47 please?
10:47 THE WITNESS: I don't have it on my screen.
10:47 RECROSS-EXAMINATION
10:47 BY MR. REDJAIAN:
10:47 Q. Sorry. Do you see it now?
10:47 Question: "The Yonah processor did not have a PCU,
10:47 correct?

10:47 "It did not have a controller named PCU. It has a logic. It has a power -- it had power management logic."

Is that correct?

A. Yes.

MR. REDJAIAN: And let's go to Line 10.

BY MR. REDJAIAN:

Q. And the next question/answer: "The Yonah processor did not have autonomous mode, correct?

Answer: "The Yonah processor did not have hardware-based autonomous. Yes."

Correct? Did I --

A. Yes. Autonomous is Speed Shift.

MR. REDJAIAN: And let's go to Line 25, Question, and then the top of Line -- Page 251.

BY MR. REDJAIAN:

Q. And your counsel asked you a question about this, correct, just now?

Let me read it.

Question: "And the Yonah processor didn't have a programmable clock controller circuit, right?

Answer: "The Yonah processor had an interface with motherboard-embedded controller that performed some of the functions that we have discussed under the big umbrella of HWP, even though it's one of them. The balancer type. The power management type."

10:49 Did I read that correctly?
10:49 A. I was referring -- this one --
10:49 THE COURT: He asked you did he read that correctly.
10:49 BY THE WITNESS:
10:49 A. Yeah. You read it correctly.
10:49 BY MR. REDJAIAN:
10:49 Q. Okay. And this is referring to a motherboard-embedded controller, correct?
10:49 A. Yes.
10:49 Q. And the motherboard is not on the Yonah chip, correct?
10:49 A. Correct.
10:49 Q. The motherboard is on the computer system, correct?
10:49 A. Yes.
10:49 Q. It's not part of the Yonah processor?
10:49 A. Correct.
10:49 Q. The mother -- the Yonah chip that you showed the jury doesn't have this motherboard-embedded controller, correct?
10:50 A. Correct.
10:50 Q. Thank you.
10:50 THE COURT: Are you done, Counsel?
MR. REDJAIAN: Yes.
THE COURT: Mr. Mueller?
MR. MUELLER: Yes. I just have a couple of final questions, Your Honor.

THE COURT: Okay. Whatever you want.

MR. MUELLER: Thank you very much.

10:50 If we could just pull that same page back up.

10:51 (Clarification by the reporter.)

10:51 FURTHER DIRECT EXAMINATION

10:51 BY MR. MUELLER:

10:51 Q. Now, you were asked about the answer from Lines 2 to 8; is that right, sir?

10:51 A. Yes.

10:51 Q. Let's look at the very next question.

10:51 Question: "The Yonah processor itself didn't have a programmable clock controller circuit, correct?

10:51 Answer: "The Yonah processor had a PLL with -- with ratio input and logic that controlled the -- the PLL -- the single PLL that generated the clock for the bus and the cores."

10:51 Do you see that, sir?

10:51 A. Yes.

10:51 Q. Is that true?

10:51 A. Yes.

10:51 Q. Did the Yonah chip include a programmable clock controller?

10:51 A. Yes.

10:51 Q. Within the chip itself?

10:52 A. Within the chip itself.

10:52 Q. Not some separate computer?

10:52 A. Correct.
10:52 Q. Within the chip itself?
10:52 A. Yes.
10:52 Q. And who came up with that idea?
10:52 A. We did.
10:52 Q. Thank you, sir.

FURTHER RECROSS-EXAMINATION

BY MR. REDJAIAN:

10:52 Q. Just a couple of follow up questions. If we can pull up that same exact question and answer, please.

10:52 In your answer, Dr. Rotem, you said, "The Yonah processor had a PLL with ratio input and logic that controlled the PLL -- the single PLL that generated the clock for the bus and the cores."

10:52 Do you see that?
10:52 A. Yes.
10:52 Q. Okay. You never mentioned that it has a programmable clock controller?
10:52 A. I did. A few lines earlier.
10:52 Q. Well, so you're talking about the motherboard?
10:52 A. No. No. Above this. You're pointing to the wrong place.
10:53 Q. Well --
10:53 A. There is -- there is there an ASL code.
10:53 Q. Okay. So --

10:53 A. I can explain if you want.
10:53 Q. I think your counsel did.
10:53 Let me just ask you: The reference to a PLL circuit, that's just a clock circuit, correct?
10:53 A. Yes.
10:53 Q. Okay. And you mentioned that the Yonah had hardware -- it had power management logic?
10:53 A. It did have also power management logic.
10:53 Q. Thank you.
10:53 Just one more. The motherbed-embedded [sic] controller that you mentioned that I asked you about, that's on the motherboard, correct?
10:54 A. This is -- yes. This is not the programmable --
10:54 Q. Well, just yes or no, if it's okay.
10:54 A. Yes.
10:54 Q. Okay. Thank you.
10:54 And the Yonah processor had an interface to a motherboard-embedded controller, correct? Yes or no.
10:54 A. Okay. Yes.
10:54 Q. And the motherboard-embedded controller was not on the Yonah processor? Yes or no.
10:54 A. It was not on the Yonah processor. This is not --
10:54 Q. Yes or no.
10:54 A. -- the programmable clock controller.
10:54 Q. Okay. I'm going to ask you again.

10:54 A. Yes.
Q. The interface -- the motherboard-embedded controller was not on the Yonah chip? Yes or no.
A. Yes. Correct.
Q. Thank you.
MR. MUELLER: I have no further questions for Dr. Rotem, Your Honor.
THE COURT: Okay. Can we ask it affirmatively?
MR. REDJAIAN: Okay. Let me re-ask it.
BY MR. REDJAIAN:
Q. The embedded controller was on the motherboard and not on the Yonah processor, correct?
A. Yes.
Q. Thank you. That's all I have.
MR. MUELLER: I have nothing further, Your Honor.
THE COURT: You may step down, Doctor.
You are free to leave.
Is he free to -- Counsel for plaintiffs, do you dismiss him?
MR. REDJAIAN: Yes.
THE COURT: You're free to leave or you're free to stay.
THE WITNESS: Thank you.
MR. MUELLER: Your Honor, Intel calls as its next witness Dan Borkowski.
THE COURT: Okay.

10:56 MR. MUELLER: Can we pass out the exhibits?
10:56 THE COURT: Yes.
10:56 (The witness was sworn.)
10:56 DIRECT EXAMINATION
10:56 BY MR. MUELLER:
10:57 Q. Good morning, sir. Could you please introduce yourself to the ladies and gentlemen of the jury?
10:57 A. Hi. My name's Dan Borkowski. I'm an engineer with Intel, and I currently live in Massachusetts.
10:57 Q. Sir, where'd you go to college?
10:57 A. I went to undergraduate school at Rose-Hulman Institute of Technology in Indiana, and I graduated with a bachelor's degree in electrical engineering and computer science in 1985.
10:57 Q. And did you continue your studies after you earned your bachelor's degree?
10:57 A. Yes. I did. I went to Rensselaer Polytechnic Institute, and I graduated with a master's degree in electrical engineering in 1987.
10:57 Q. Now, today you work at Intel; is that right?
10:58 A. That's correct.
10:58 Q. For how long have you worked at Intel?
10:58 A. About 20 and a half years.
10:58 Q. Now, could you tell the jury a little bit about what you did in between getting your master's degree in electrical

engineering and joining Intel?

A. Yeah. My master's specialty was in signal processing, and I started my career doing that for a telephone company, ended up doing some cellular telephone work. And eventually I ended up working in Houston in -- for a company that did oil drilling equipment.

Q. Now, what is your current position at Intel?

A. I'm a principal engineer.

Q. And what are your responsibilities as a principal engineer at Intel?

A. I have supervisory responsibilities for half a dozen engineers, and I also will typically lead in my specialty, which is called P-code, I will typically lead one or more projects and manage the activities of a team.

Q. What is P-code?

A. So within a computer chip, there is a microprocessor that runs -- that controls the power and performance. And the software that runs on that microprocessor, that microcontroller, is called P-code.

Q. What is the name of that microcontroller?

A. The microcontroller is -- it's in the PCU.

Q. PCU?

A. PCU.

Q. Now, the jury has heard from Jonathan Douglas and Dr. Efraim Rotem. Do you know them?

10:59 A. I do.
10:59 Q. They work on architectures for Intel microprocessors. Do you know that?
10:59 A. Yes.
10:59 Q. What is the relationship between the work of architects, like Dr. Rotem and Mr. Douglas, and what you and your colleagues do in the P-code group?
10:59 A. So typically folks like Dr. Rotem will come up with algorithms and specifications, and me and my team will take those specifications and turn them into software that runs in the PCU.
11:00 Q. You write the actual code?
11:00 A. We write the code, the P-code.
11:00 Q. Sir, do you have any patents?
11:00 A. I do.
11:00 Q. About how many?
11:00 A. 12 or so.
11:00 Q. Now, are you familiar with an Intel product called the Skylake processors?
11:00 A. Yes.
11:00 Q. What are they?
11:00 A. That's a family of processors. There was a client version and a server version. I worked on the server version.
11:00 Q. And what personally did you do with respect to this server version?

11:00 A. I led the team that implemented the P-code.
11:00 Q. Now, what do you mean when you say a client version and a server version? What are the differences between those?
11:00 A. So a client CPU is one that we would -- would typically be sold to be put into, say, a laptop computer. A server chip is typically much bigger, has a lot more functionality. And it's sold to companies like Google who put it into big data centers.
11:00 MR. MUELLER: Your Honor, may I approach the witness?
11:01 BY MR. MUELLER:
11:01 Q. Mr. Borkowski, I've handed you a plastic bag labeled "DPX 6." If you could open that up. And do you recognize what's inside?
11:01 A. Yeah. This is a Intel Xeon Mark processor, probably Skylake server.
11:01 Q. Now, that's a much bigger chip than some other chips we've seen in this case. Why is it bigger?
11:01 A. It has a lot more functionality. It's designed for a different purpose.
11:01 Q. Where were the Skylake server products developed?
11:01 A. Primarily in the United States spread around to four or five Intel facilities within the U.S.
11:01 Q. And how long did it take the folks at Intel to create those Skylake server chips?
11:01 A. From concept to production is typically four to five

years.

Q. And how many components are in a chip like the one you have before you?

A. I couldn't give an exact number. It's thousands.

Q. Now, are you familiar with something called Speed Shift clock control technology?

A. Yes. I am.

Q. What is it exactly?

A. It's a set of algorithms for determining and setting frequencies.

Q. Is there any other name that you've heard it referred to within Intel?

A. Within Intel we call it hardware P-states. The nickname is HWP.

Q. And that's H-W-P?

A. Yes.

Q. Now, how did your work on P-code relate to the Speed Shift technology, you and your colleagues' work on P-code relate to Speed Shift?

A. So within the Skylake server processor, my team implemented all of the P-code, including the P-code for the HWP feature.

Q. So I'm going to represent to you that the jury just heard from Dr. Rotem on some of the architecture for the Skylake products. What did your team do with those

11:02 architectures?

A. We took those architectures and the specifications and we wrote the code to implement them.

MR. MUELLER: Now, let's put -- Your Honor, may I turn off the public monitors for Intel?

THE COURT: Of course.

MR. MUELLER: If we could turn off the public monitors and we'll put up D-255.

BY MR. MUELLER:

Q. Sir, this is titled "Skylake HAS." Are you familiar with this type of architectural document?

A. Yes. I am.

Q. And what do you and your team do with these types of documents?

A. So these types of documents, which typically would come from architects like Efi Rotem, they would be the inputs to what our requirements are. They would specify the things that we're supposed to implement in the P-code.

MR. MUELLER: We can take this document down.

BY MR. MUELLER:

Q. Now, how many engineers work on P-code at Intel?

A. All told, between client and server, it's probably around 50.

Q. And are you the longest-serving member of that group?

A. I am. Yes.

11:04 Q. How many lines of P-code, individual lines of computer P-code are there in the Skylake server products?

11:04 A. About 60,000.

11:04 Q. And if we look at the client products, how many lines of P-code are in those?

11:04 A. So client is smaller. Probably 40,000 or so.

11:04 Q. How many lines of server P-code did you personally write in the Skylake server products?

11:04 A. So we typically will use the code from one project to start the basis for the next project. I've been doing this for more than 15 years. Probably 25 or 30 percent of the code.

11:04 Q. And about how many thousands of lines of code are we talking about?

11:04 A. Maybe 12, 15,000. Maybe more.

11:04 Q. Now, sir, if you'd just hold up that Skylake server chip one more time.

11:04 I want to show you DDX-9.2. What is the relationship between what we see here on the screen and that physical Skylake server chip in front of you?

11:05 A. So what we're seeing on the screen is like a magnified version of what you would see if you kind of skimmed the cover off the top of the chip.

11:05 Q. Now, I want to ask you about how some of the components in the Skylake server worked. Okay?

11:05 A. Okay.

11:05 Q. So I have a block diagram here. And I'll represent to you that this looks like a diagram that we -- I just constructed with the jury at the direction of Dr. Rotem, but I want to ask you some questions with respect to the server products. Okay?

11:05 A. Okay.

11:05 Q. For the server products, is there anything in here that we should remove for the server products?

11:05 A. Server products don't have graphics so we could take that out along with the clock for it.

11:06 Q. Anything else?

11:06 A. No. The other stuff is there, but some things are changed.

11:06 Q. And what is changed in particular?

11:06 A. In the servers we don't have a ring. We have something we call a mesh.

11:06 Q. So I have here a component labeled "Mesh." What is that?

11:06 A. A mesh is like a ring, but it's a more complicated ring because typically we'll have more cores. And we need more interconnects and more bandwidth to communicate between all those cores.

11:06 Q. So I have some additional cores here. There's more cores in a server chip than a client chip?

11:06 A. Yes. Typically.

Q. So I'll put these additional cores up here. Where would the mesh go in this diagram?

A. You could put it around that lower set of cores because it interconnects the cores together plus the last-level cache.

Q. About there?

A. Yeah, that works.

Q. Now, do you know what a clock is in the context of these Intel processors?

A. Yes. I do.

Q. What is it?

A. A clock is what sets the frequency of the various components.

Q. So here we have some blue clocks for the cores. Do you know what those represent?

A. Each core has its own clock.

Q. And we have a yellow clock here adjacent to the mesh. Do you know what that is?

A. Yeah. That would be the clock that controls the speed of the mesh plus the last-level cache.

Q. And what is the last-level cache?

A. It's an on-chip memory that stores data so that we don't have to go out to the main memory as often, and it improves the performance of the CPU.

Q. Is the clock for the mesh the same or different than

the clocks for the cores?

A. It's different.

Q. Now, do you see that piece labeled PCU?

A. Yes.

Q. Is that the PCU you were referring to a few minutes ago?

A. Yes. That's where the P-code exists.

Q. And that's the P-code that you and your colleagues actually write?

A. Correct.

Q. Now, I want to ask you a few questions about how this set of components worked together. Okay? Do you have that in mind?

A. Yes.

Q. First, are you familiar with something called the C0 residency information?

A. Yes. I am.

Q. What is it?

A. So when a core is executing, it's in a state that we call C0, means it's active. It's executing software on it.

If it's not in C0, it would be in C1, C2 or a higher number, and those are various forms of sleep.

C0 residency is a measure of how much -- how during a period of time, how much of that time was the core awake.

Q. Are you familiar with a term called P-state with

respect to these processors?

A. Yes. I am.

Q. What is a P-state?

A. P-state is an internal name that we have for the frequency for the various components.

Q. What, if anything, in the Skylake products controls the P-state?

A. It's the P-code with the help of some hardware in the PCU.

Q. So I want to ask you some questions about how the PCU and the P-code running on the PCU control clock speed. Do you have that in mind?

A. Yes.

Q. What information does the PCU use to determine the P-state?

A. So there's a number of factors.

First are some configuration parameters, but there's also some telemetry that is received by the PCU that the P-code and the PCU can use to determine target frequencies.

Q. What is telemetry data?

A. Telemetry data is a set of data that are pushed on a regular basis from various components, including the cores, to the PCU.

Q. And what do you mean by "pushed on a regular basis"?

A. So there are like frames of information, and within a

frame, you will have certain parameters at certain offsets in the frame. And when the frame is done, another frame will come. It'll have this -- new copies of the same information. It's just continually sending it.

Q. And, sir, if you could, using the touch screen, if you could just show where the information's coming from and where it goes to.

A. So it would come from the cores. As an example there. We also get it from other pieces of logic that are in the CPU.

Q. Does the PCU request this information?

A. No. It doesn't.

Q. What triggers it to be sent to the PCU?

A. There's no explicit trigger. It's telemetry. It's coming all the time over and over and over.

Q. Well, how do you know that?

A. That's the way it works. It's how it's specified.

Q. I want to ask you about the actual P-code that you and your colleagues have written, okay?

A. Okay.

MR. MUELLER: Your Honor, I am going to have to ask for Your Honor's permission to seal the courtroom for this source code discussion.

THE COURT: Is there anyone in the courtroom that is not under the protective order?

11:11 MR. MUELLER: And if we could also turn off the public feed, Your Honor.
11:11 THE COURT: We'll turn off the public feed.
11:11 MR. MUELLER: Thank you.
11:11 (Sealed proceedings.)
11:27 MR. MUELLER: Your Honor, we can unseal the courtroom at this point.
11:27 THE COURT: Thank you for telling me.
11:27 BY MR. MUELLER:
11:27 Q. Just a few final questions, Mr. Borkowski.
11:28 Do you enjoy your work at Intel?
11:28 A. Yeah. I love my job.
11:28 Q. And what do you like about it?
11:28 A. We get to do really interesting stuff. We get to work on really interesting problems, and we produce products that, you know, benefit the world.
11:28 Q. Before this case had been filed, had you heard one word about the '373 patent --
11:28 A. No.
11:28 Q. -- asserted by VLSI in this case?
11:28 A. No.
11:28 Q. Before this lawsuit had been filed, had you heard one word about the '759 patent asserted by VLSI?
11:28 A. No.
11:28 Q. Who created the P-code that you've discussed with the

jury?

A. That's a product of me and my team.

Q. And whose ideas are in it?

A. It's all our ideas and ideas of our architects.

Q. Thank you, sir.

MR. MUELLER: I have no further questions.

MR. REDJAIAN: Your Honor, may I have five minutes to set up?

THE COURT: Nope.

MR. REDJAIAN: Okay.

THE COURT: We've got to go.

MR. REDJAIAN: Okay.

THE COURT: Remember I have to take a break in about 25 minutes. That's why I'm trying to get through this gentleman all at one time.

Do you perceive you're going to have more than 25 minutes --

MR. REDJAIAN: No. I'm going to keep this very short, Your Honor.

THE COURT: I mean, take what time you need to get ready. I'm just not going to move the jury. We can sit here. I just don't want them --

MR. REDJAIAN: Okay. Thank you. Just one second, Your Honor.

CROSS-EXAMINATION

11:30 BY MR. REDJAIAN:
11:31 Q. Good morning, Mr. Borkowski.
11:31 A. Good morning.
11:31 Q. Now, you're familiar with the Lake processors, correct?
11:31 A. I am. Yes.
11:31 Q. And all the Lake processors have a PCU, correct?
11:31 A. Correct.
11:31 Q. And the PCU in all of the Lake processors have a microcontroller, correct?
11:31 A. Correct.
11:31 Q. And the microcontroller runs what's called P-code, correct?
11:31 A. Correct.
11:31 Q. And P-code is programmable code that the microcontroller runs?
11:31 A. Yes. Correct.
11:31 Q. And it's stored in an embedded memory within the PCU?
11:31 A. Yeah. Among other things. Yes.
11:31 Q. And you're familiar with the term "Speed Shift"?
11:32 A. Yes. I am.
11:32 Q. Yeah. You testified about it this morning?
11:32 A. Yes.
11:32 Q. Okay. And it's also sometimes referred to as HWP; is that correct?

11:32 A. Yeah. That's our internal code name for it, our nickname.

11:32 Q. And that's hardware performance state?

11:32 A. We call it hardware P-states.

11:32 Q. Okay. Thank you.

11:32 And HWP is intended to try to help that balance performance and power. Would you agree with that?

11:32 A. I don't know if I'd quite say it that way.

11:32 Q. HWP is a set of algorithms that are intended to try to help balance performance and power consumption. Would that be correct? Yes or no.

11:32 A. Yeah.

11:32 Q. And the goal of HWP is try to improve the energy efficiency of the product while helping performance of the product increase, correct? Yes or no.

11:33 A. That's one of the goals. Yes.

11:33 Q. And the cores, PCU, P-code all have pieces of the HWP algorithm, correct?

11:33 A. Could you repeat the question, please?

11:33 Q. Sure. The cores, PCU, P-code all have pieces of the HWP algorithm?

11:33 A. Yeah. Among other things, yes.

11:33 Q. Thank you.

11:33 Switching topics. Now, are you familiar with custom reference boards?

11:33 A. I know of them. I'm not intimately familiar.
11:33 Q. Well, typically, as Intel releases a new processor, they have a custom reference board that they use. Would that be accurate?
11:33 A. That's typical. Yes.
11:33 Q. And they do that for each processor?
11:34 A. Far as I know, yes.
11:34 Q. And they do that for the Lake processors?
11:34 A. Yes.
11:34 Q. And Intel uses the reference boards to test out various aspects of HWP functionality, correct?
11:34 A. Yeah, among other things. Yes.
11:34 Q. They use it -- sorry. They use a custom reference board to test functionality of the chip, correct?
11:34 A. Yes. That's one of the ways they use it. Yes. Sure.
11:34 Q. And they also use to test the Speed Shift functionality of the chip, correct?
11:34 A. In the products that I'm familiar with, yes.
11:34 MR. REDJAIAN: Just one more second, Your Honor.
11:34 (Conference between plaintiff counsel.)
11:35 MR. REDJAIAN: I have nothing further. Thank you, Mr. Borkowski.
11:35 MR. MUELLER: Nothing further, Your Honor.
11:35 THE COURT: May this witness be excused?

11:35 MR. MUELLER: Yes, Your Honor.
11:35 MR. REDJAIAN: Yes. Thank you.
11:35 THE COURT: You're free to stay. You're free to go back home to Massachusetts. Thank you for being here.
11:35 THE WITNESS: Thank you.
11:35 THE COURT: Mr. Lee, who do you think would your next witness be?
11:35 MR. REDJAIAN: Well, I had one other issue, Your Honor, that I need to address before the next witness, and we need to address -- we talked about it earlier this morning and I think you said we should push it to later. Can we do that?
11:35 THE COURT: This is the third witness that we talked about this morning?
11:35 MR. REDJAIAN: Yes.
11:35 THE COURT: Why don't we do this --
11:35 MR. LEE: I can make a suggestion, Your Honor, to make use of the jury's time. The next witness is Dr. Grunwald, who Ms. Sooter will be presenting. If we could put him on, we could do his qualifications, and we could use the time.
11:36 THE COURT: That'd be great. Thank you very much.
11:36 MR. REDJAIAN: Thank you.
11:36 THE COURT: And, ladies and gentlemen, I'm causing a problem here. I'm speaking on a panel virtually at noon. I had scheduled -- I thought I was going to be free today because I thought this trial would be last week, so I can't get out of

that speaking role. So I apologize for the inconvenience to you all.

Doctor, if you'd -- is it doctor?

THE WITNESS: Yes.

(The witness was sworn.)

MS. SOOTER: Professor Grunwald, would you like to try out the microphone, as will I?

THE WITNESS: Yeah. Is this clear enough?

MS. SOOTER: Everybody okay? Great. May I proceed?

THE COURT: Yes, ma'am. Please.

DIRECT EXAMINATION

BY MS. SOOTER:

Q. Good morning, sir. Can you please introduce yourself to the jury?

A. Hi. My name is Dirk Grunwald. I'm a single dad of three from Colorado and, despite appearances, like hiking and mountain biking.

Q. Now, the jury has been hearing about two patents in this case. Which one are you here to talk about?

A. The '759 patent, the one on clock control.

Q. Can you please describe your education to the jury?

A. Yeah. I received a bachelor's, master's and Ph.D. degrees in computer science all from the University of Illinois.

Q. And what do you do for a living?

11:38 A. I'm on the faculty at the University of Colorado Boulder.

Q. Are you a professor there?

A. Yes.

Q. What do you do as a professor at the University of Colorado?

A. So I'm a professor in the department of computer science, and then I also hold an appointment in the electrical and computer engineering department. And my job is broken into the three parts: Research, teaching and service.

Q. Let's start with teaching. What classes do you teach generally?

A. Classes on computer systems. Right now I'm teaching a class called computer systems. We started with 350 students, but we had an exam, so it's down.

Q. Have you taught university courses involving clock control and microprocessors?

A. Yes.

Q. Now, what technologies have you researched?

A. So, again, broadly the area of computer systems, ranging from high performance computing to energy efficient computing, clock control as part of that storage systems networking.

Q. Has your research led to published papers?

A. Yes. Well over 200.

11:39 Q. And has your research involved clock control and microprocessors?
11:39 A. Yes.
11:39 Q. Have you published papers in that area?
11:39 A. Yes.
11:39 Q. About how many?
11:39 A. About 20ish overall in the general area of power control.
11:39 MS. SOOTER: Can we bring up Exhibit D-264, please?
11:40 BY MS. SOOTER:
11:40 Q. Professor Grunwald, what is Exhibit D-264?
11:40 A. So this is a paper I authored with some students and then a colleague from industry.
11:40 Q. When did you publish this paper?
11:40 A. The year 2000.
11:40 Q. And what's the title?
11:40 A. Policies for Dynamic Clock Scheduling.
11:40 Q. Can you tell us in a little more plain English what the paper is about?
11:40 A. Yeah, so we had access to one of the first processors with variable clock control. That was made by Intel at the time, and we were trying to determine what were the best policies for an operating system to use to change the clock speeds.
11:40 Q. How many other papers on clock speeds and power

management have you published in total?

A. In power management about 20ish.

Q. Okay. And has any of your research been funded by industry?

A. Yes. I've gotten funding from Hewlett-Packard Corporation, IBM, Digital Equipment Corporation, I think Compaq, Intel, a couple of smaller companies.

Q. Have there been other organizations that have funded your research?

A. Yes. The National Science Foundation and then DARPA which is the Defense Advanced Research Projects Association.

Q. What is DARPA?

A. They're the people who invented the Internet and funded autonomous card development, things like that. So they fund advanced research that they're interested in.

Q. And they fund your work as well?

A. Yes.

Q. Now, Professor, I'd like you to be immodest for just a moment, if you would. Have you won any awards for your work?

A. Yes. Both research and teaching awards.

Q. What are some examples of the research and teaching awards that you've won?

A. Well, we got what's called a best paper award two years ago in a big conference on some mobile computing, and I also received a paper of something called a Test of Time Award,

so it's an award for a publication 15 years prior that has withstood the test of time. But I'm also most proud, I have to say, of my teaching awards that I received from undergraduates.

MS. SOOTER: Your Honor, at this time Intel offers Professor Grunwald as an expert in computer architecture and the technology relating to the '759 patent.

MR. CHU: No objection, Your Honor.

THE COURT: Great. Doctor, we're going to take a break. My schedule requires it. I'm sure the jury won't mind having an extra six minutes. Every minute counts. And so let's do this.

My talk goes from 12:00 until 1:00. I would invite you all to listen in, but you all might not come back. So...

(Laughter.)

THE COURT: And so why don't we do this? Let's plan on -- I'll plan on coming back here around 1:15 if that works for you all. I appreciate your courtesy with me.

Doctor, you may step down.

Remember my instructions not to discuss the case amongst yourselves. We will be in recess.

DEPUTY CLERK: All rise.

(Jury exited the courtroom at 11:43.)

THE COURT: If we can do it quickly, let's take up the issue we have with this gentleman.

MR. REDJAIAN: Yes, Your Honor. There's a slide that

talks about --

THE COURT: Can you show it to me or hand it to me? Hand to me is probably quicker. Okay.

MR. REDJAIAN: So Your Honor granted a MIL on claim construction and said ordinary meaning, you're not allowed to give construction that departs from that.

This is from the prosecution history of the patent, and they're going to try and give a different meaning to what the claim term is, the request term is using the prosecution history which goes against your MIL.

And Your Honor also addressed the prosecution history MIL, and in that opposition to that MIL, they represented they would not make claim construction arguments from prosecution history, and we relied on that and now we see this slide.

THE COURT: Okay. Counsel?

MS. SOOTER: Your Honor, this is the same issue that you ruled on during Dr. Conte's cross when Mr. Lee was crossing Dr. Conte.

Dr. Conte is making arguments under the Doctrine of Equivalents, and we had filed a motion saying that -- sorry -- prosecution history estoppel prevents that and Your Honor had left it over for a question of fact for trial. Or at least a question for trial, and so this is evidence that goes to whether or not prosecution history estoppel precludes their DOE argument.

11:45 And we're not -- certainly not trying to change the plain and ordinary meaning of the claims with it in any event.

THE COURT: Understood.

MR. REDJAIAN: May I address that, Your Honor?

THE COURT: Of course.

MR. REDJAIAN: Prosecution history estoppel is a legal argument, Your Honor. It's a legal question for you to determine, and so it would be improper to have this in front of the jury. And we relied on this based on their representation.

THE COURT: Understood. Anything else?

MS. SOOTER: No, Your Honor. Other than the fact that you did already decide the issue and that the evidence will need to come in somehow now that we're at trial here.

THE COURT: Understood.

MR. CHU: May I add, Your Honor, there are two very important decisions.

The first, which is the less important one, is the Federal Circuit Festo case which stated, quote, "Questions relating to the application in scope of prosecution history estoppel thus fall within the exclusive province of the Court.

"Accordingly, the determinations concerning whether the presumption of surrender has arisen and whether it has been rebutted are questions of law for the Court, not a jury to decide."

Second, more important decision, reads in part:

11:46 "Questions relating to the application in scope of prosecution history estoppel fall within the exclusive province of the Court and determinations concerning whether the presumption of surrender has arisen and whether it has been rebutted are questions of law for the Court, not a jury to decide," and that's the Lighthouse Consulting Group case, Albright J.

THE COURT: Thank you, sir.

Anything else?

MS. SOOTER: I think that's it, Your Honor, other than this evidence is already of the type that has come in through Dr. Conte's cross, and this would just be consistent with that.

THE COURT: Anything else?

MS. SOOTER: Or through our own witness. Thank you. Sorry.

THE COURT: No.

MR. CHU: No.

THE COURT: Okay. I'm going to think about this. You all will know shortly. I'll have Evan or Josh let you know whether or not it's going to be admissible.

I'm going to take this back and think about it for just a couple of minutes.

Anything else we need to take up before the lunch break?

MR. CHU: No, Your Honor.

THE COURT: Okay. Very good. Thank you.

THE BAILIFF: All rise.

11:47 (Recess taken from 11:47 to 1:26.)

01:27 THE BAILIFF: All rise.

01:27 THE COURT: Thank you. You may be seated.

01:27 Counsel, what I'm going to do with respect to DDX-10.37 is -- the only way I can figure out how to do this is to have Intel put the doctor on the witness stand. I want to hear the questions and answers, but I want you to know if I have to take the time to do this, whoever loses the time it takes me to do this, it's going to come out of their time.

01:27 So there has to -- so if Intel wants to have this and believes they have the right to have this exhibit in, that's fine. If VLSI believes it's inappropriate, that's fine, but I'm going to assess the time against whoever I determine was incorrect. And this is the way I'm going to do it, if you want me to continue to consider whether or not to allow this document in.

01:28 Mr. Chu, is that what you want me to do?

01:28 MR. CHU: As I understand, Your Honor, let's just do it the old-fashioned way, questions and answers and objections along the way.

01:28 THE COURT: That was going to be my other alternative. That's what I -- this was why it's bad to have really smart clerks because that was my suggestion. And my clerk said, no. There's a better way.

01:28 And so because they're really smart. So sometimes it's

01:28 better to be old than really, really smart.
01:28 So in that case someone will gather the jury and bring
01:28 them in. I'm just going to wait here for them and, William,
01:28 will you knock? Actually I'll stand out there and wait for
01:28 them out there. Then we'll come back in together.
01:31 THE BAILIFF: All rise.
01:31 THE COURT: Please remain standing for the jury.
01:31 (The jury entered the courtroom at 1:31.)
01:31 THE COURT: Thank you. You may be seated.
01:31 Doctor, if you would take your seat again, please.
01:32 BY MS. SOOTER:
01:32 Q. Good afternoon.
01:32 A. Good afternoon.
01:32 Q. Let's make sure that microphone is nice and close.
01:32 Okay?
01:32 A. Yep.
01:32 THE COURT: And you need to move your microphone closer to
01:32 you too, please.
01:32 MS. SOOTER: Thank you.
01:32 BY MS. SOOTER:
01:32 Q. Professor Grunwald, what were you asked to do in this
01:32 case?
01:32 A. So first I was asked to determine if the Intel Lake
01:32 series products infringe the '759 patent. Then I was also
01:32 asked to determine if the '759 patent is valid, given the prior

art.

Q. Do Intel's Lake series processors infringe the '759 patent?

A. No.

Q. Is the '759 patent valid?

A. No.

Q. Have you prepared some slides to help with your testimony?

A. Yes.

MS. SOOTER: We're going to be using DDX-10, and let's start with Slide 2, please.

BY MS. SOOTER:

Q. Professor Grunwald, we see PTX-5. What is this document?

A. This is the '759 patent cover sheet.

Q. When did the '759 patent issue?

A. May 25th of 2010.

Q. That's when the Patent Office granted it?

A. Yes.

Q. When did you first hear of this patent?

A. In August of 2019.

Q. By 2019 how long had you been working on clock control techniques?

A. About 20 years.

MS. SOOTER: Let's go to Slide 3, please.

01:33 DEPUTY CLERK: Counsel, there are no exhibits up.
01:34 BY MS. SOOTER:
01:34 Q. If we could turn to Slide 3, Professor Grunwald, what
01:34 do we see here?
01:34 A. So this is an illustration that I'm going to use to
01:34 talk about parts of the '759 patent.
01:34 Q. Can you please walk us through it at a high level?
01:34 A. Yes. So first off, I'll just go from left to right.
01:34 There is a clock. And so many electronics systems have what's
01:34 called a base clock or a reference clock -- and in the patents
01:34 it's called a clock.
01:34 And this then has a clock beat indicated by the signal,
01:34 the gray line here, that then is sent to a clock controller.
01:34 And the clock controller has an output called the output of the
01:34 high-speed clock.
01:34 And that clock signal, that's the gray signal that's here.
01:35 That's provided to two devices, the first device and the second
01:35 device, that are connected by a bus. So the bus is the
01:35 communication interconnect mentioned earlier.
01:35 MS. SOOTER: Let's go to Slide 4, please.
01:35 BY MS. SOOTER:
01:35 Q. What do we see here?
01:35 A. So these are the claims. This is Claim 14. This is
01:35 the elements or requirements of the claim.
01:35 Q. Can we walk through this claim together?

01:35 A. Yes.
01:35 MS. SOOTER: Let's go to Slide 5.
01:35 BY MS. SOOTER:
01:35 Q. What does requirement 14A say?
01:35 A. So it says "a system comprising a bus capable of
01:35 operation at a variable clock frequency."
01:35 Q. And where is a bus on the figure on the left?
01:35 A. It's the yellow thing labeled bus.
01:35 MS. SOOTER: And let's go to Slide 6, please.
01:35 BY MS. SOOTER:
01:35 Q. Requirement 14[B] says "a first master device coupled
01:35 to the bus." Where do we see that on the figure?
01:36 A. That's this, the thing labeled "first master device."
01:36 Q. What does claim requirement 14[B] require the first
01:36 master device be configured to provide?
01:36 A. So it must be configured to provide a request to
01:36 change a clock frequency of a high-speed clock.
01:36 Q. Where do we see that request?
01:36 A. That's this red line, so that's the request.
01:36 MS. SOOTER: Let's go to Slide 7, please.
01:36 BY MS. SOOTER:
01:36 Q. Under what circumstances is a first master device
01:36 configured to send a request?
01:36 A. So it says, "in response to a predefined change in
01:36 performance of the first master device, wherein the predefined

01:36 change in performance is due to loading of the first master device as measured within a predefined time interval."

MS. SOOTER: If we could go to Slide 8.

BY MS. SOOTER:

Q. Can you give us an example of when that would happen?

A. Yes. So in this case the first master device is doing some work. It then determines that it's busier over some period of time and then sends, for example, a request for a faster clock speed to the clock controller.

Q. Professor Grunwald, would a system that does not have a master device configured to provide a request to change a clock frequency infringe Claim 14?

A. No.

MS. SOOTER: Let's go to Slide 9.

BY MS. SOOTER:

Q. What do Requirements 14[D] and 14[E] say?

A. So they describe "a programmable clock controller having an embedded computer program therein, the computer program including instructions to receive the request provided by the first master device." And so the request flows from the first device to the clock controller.

Q. And the clock controller is the box in orange?

A. Yes. That's this.

MS. SOOTER: Let's look add Slide 10, please.

BY MS. SOOTER:

01:37 Q. What does 14[F] require?
01:38 A. So then "provide the clock frequency of the high-speed clock as an output to control a clock frequency of a second master device coupled to the bus in response to receiving the request provided by the first master device."
01:38 MS. SOOTER: And going to Slide 11.
01:38 BY MS. SOOTER:
01:38 Q. What does 14[G] require?
01:38 A. So then "and provide the clock frequency of the high-speed clock as an output to control the variable clock frequency of the bus in response to receiving the request provided by the first master device."
01:38 Q. And where in the figure on the left do we see what 14[F] and 14[G] describe?
01:38 A. So this is the frequency of -- sorry -- the clock frequency of the high-speed clock as an output to control the bus and as an output to control the second master device.
01:38 Q. Is there a shorthand term that you use to describe requirements 14[F] and 14[G]?
01:39 A. Yeah. And to be clear, this is just my shorthand. I'm going to use the phrase "common clock" because again, the claims F and G are saying provide the clock frequency of the high-speed clock as an output to control. And that's just a mouthful.
01:39 Q. So if I say common clock or common control, then you

would know that I mean 14[F] and 14[G]?

A. Yes, the wording of those.

Q. And in doing so, are you ignoring or -- any language of the claims?

A. No.

Q. Now, if a system did not meet the common control requirements of 14[F] and 14[G], would it infringe?

A. No.

Q. Looking at Slide 12, can you please summarize Claim 14 using this diagram?

A. Yes. So in essence, the first device sends a request. Based upon the request, the clock controller changes the clock speed.

Q. So maybe we could have an animation here?

A. Yeah. And then following that, the clock speed can change, and the change has to be in response to the request.

So there's several elements there. And then the clock speed of the high-speed clock, that's the clock out of here, as an output to control a clock speed of a variable speed bus, and that's the second master device.

MS. SOOTER: Let's go to Slide 13, please.

BY MS. SOOTER:

Q. What do we see here?

A. So this is an illustration to sort of capture the sequence of operations that's going on. So the box in the

middle represents the request to change a clock frequency.

So in every case the request is made and then the clock frequency, which is represented where the clock frequency of the high-speed clock is an output to control, is changed following the request being made.

And the clock frequency of the high-speed clock -- it gets long -- it's the same for the clock control for the bus and the clock control for the second device. They're common.

So this represents what the '759 sequence of operations are.

Q. Do the Intel Lake series products work this way?

A. No, they don't.

Q. Now, we'll come back to your noninfringement opinions in a minute, okay, Dr. Grunwald?

A. Okay.

Q. Now, were you able to watch when Dr. Rotem testified this morning?

A. Yes, I was.

MS. SOOTER: Let's go to Slide 14, please.

BY MS. SOOTER:

Q. Do you recall Dr. Rotem's testimony about the timeline?

A. Yes.

Q. Dr. Rotem told us about Yonah. Where do we see Yonah on this timeline?

01:41 A. Yonah's over here in the early 2000s.
01:41 MS. SOOTER: Let's go to Slide 15, please.
01:41 BY MS. SOOTER:
01:41 Q. How does the date of Yonah compare to the date the
01:42 '759 patent was filed?
01:42 A. Yonah was -- the invention of the Yonah occurred
01:42 before the '759 patent. So it's prior art to the patent.
01:42 Q. Can you please remind us generally what Yonah was?
01:42 A. So Yonah was the core duo, so it was a CPU with two
01:42 cores and a bus and a single clock.
01:42 Q. And, generally, what time frame did Intel develop
01:42 Yonah?
01:42 A. Generally between 2002 and 2005.
01:42 Q. So, Professor Grunwald, I believe you have maybe off
01:42 to your right DPX 3.
01:42 Can you just -- I believe Dr. Rotem held this up this
01:42 morning, but can you just remind the jury what that is?
01:42 A. Yeah. So this is a Yonah processor. So pinned on
01:42 this side that would go into the motherboard and then the die
01:42 on the top here.
01:42 Q. And the die is the part that actually does the work
01:43 in there?
01:43 A. Yeah. That's where the silicon is and the circuits
01:43 are.
01:43 Q. About how big is it?

01:43 A. About the size of my thumbnail. It's underneath the metal lid.

01:43 Q. Professor Grunwald, does VLSI accuse Yonah of infringing the '759 patent?

01:43 A. No.

01:43 Q. Why then is Yonah relevant to your analysis?

01:43 A. Because Yonah was invented before the patent was filed. That's why the patent is invalid.

01:43 Q. Do you remember when Dr. Rotem testified about DDX-8.6 that I'm going to show here on the document camera?

01:43 A. Yes.

01:43 Q. Can you please describe what we see here?

01:44 A. So this is sort of a floor plan, I would call it, of the Yonah processor.

01:44 So the two cores -- so each of these represent the area occupied by the two cores of the Yonah processor. And then there's a bus that interconnects those two that are used to communicate between the cores and also to communicate to what's called the LLC, or the last-level cache.

01:44 Q. Can you please remind the jury how the clock control feature in Yonah worked?

01:44 A. Yeah. So in Yonah the cores make a request, and not all parts of the Yonah processor are shown in this simple diagram. But so basically the cores would wind up making a request, and, you know, one core or the other, and then that

would cause the PLL or what's called the clock generator to change its clock frequency.

Q. And just to clarify, the clock control feature in Yonah was called SpeedStep; is that right?

A. That's right.

Q. And that was the old way of doing clock control, right?

A. Exactly, yes.

MS. SOOTER: Let's look at Slide 16, please.

BY MS. SOOTER:

Q. What do we see here?

A. So this is an illustration of the way that clock control worked in Yonah. So again, the clock frequency is the vertical axis here, and Yonah worked by making -- there was a request to change a clock frequency. And then following that request, there was a change to the clock PLL. And because there's a single clock generator, that then changes the clock control of the bus and the clock control of the second master device.

MS. SOOTER: Let's look at Slide 17, please.

BY MS. SOOTER:

Q. How did the Yonah clock control feature compare to the later '759 patent's clock controller?

A. Oh, they function in the same way which is why the patent's invalid.

01:46 MS. SOOTER: Let's go to Slide 18, please.
BY MS. SOOTER:
Q. Turning back to our timeline, what was the date the '759 patent was filed?
A. It was filed June 29th of 2005.
Q. So about 15 years ago or so now?
A. Yeah.
MS. SOOTER: Let's look at Slide 19, please.
BY MS. SOOTER:
Q. What part of the '759 patent are we looking at here?
A. We're looking at the background section, so this is the lead-in to the summary of the patent.
Q. What type of technology does the '759 patent describe in the background section?
A. It's describing MP3 players.
MS. SOOTER: Going to Slide 20.
BY MS. SOOTER:
Q. What were MP3 players?
01:47 A. Well, first my kids tell me that I'm old because I remember this, but they had them. So they had -- they just played music, MP3 files, music files. So like an Apple iPod was a classic example at that time. They don't remember this.
Q. To be clear, are you saying the '759 patent is limited to only MP3 player technology?
A. No.

01:47 Q. But it -- was it informative to you to read the background section of the patent?
01:47 A. Yeah, yes.
01:47 Q. Dr. Grunwald, let's go to Slide 21, please. How much has technology changed since the patent was filed in 2005?
01:47 A. A tremendous amount. I had actually a Motorola Razr flip phone at the time. I used to get my Netflix movies by mail. That's pretty ancient technology by now.
01:48 Q. Going to Slide 22 and continuing with our timeline, can you remind the jury what happened in 2015?
01:48 A. Yeah. That's when Intel introduced the Skylake processor.
01:48 Q. And I think you have a Skylake processor in front of you as well. Looks very similar. We can just look at it briefly, I suppose.
01:48 A. Yeah. Yeah, they all look basically about the same. The big server ones are different. But this one, again, has the metal caps on the top and the ball (inaudible) array on the bottom.
01:48 Q. Now, Professor Grunwald, did you hear Mr. Spehar's testimony at the beginning of this trial?
01:48 A. Yes. I did.
01:48 Q. And did you hear Mr. Bearden's testimony?
01:48 A. Yes. I did.
01:48 Q. What did they say about how fast technology changes

in the microprocessor industry?

A. They said it changed at a sort of a breakneck pace and you had to keep up with that or you'd be obsolete.

Q. How much has microprocessor technology changed between Yonah in 2005 and Skylake in 2015?

A. A tremendous amount.

Q. Well, let's go to Slide 23, please. What feature did Skylake use to control clock speeds?

A. So with Skylake they introduced Speed Shift.

Q. And that's what we see in the blue bar there?

A. Right. All of those have Speed Shift.

Q. And these are the Lake series processors over on the right?

A. That's right.

Q. So starting in 2015 all the way up to the present day, right?

A. Yes.

Q. And Yonah's clock control, I think we've established, was the old way and Speed Shift was the new way, right?

A. Yes.

Q. What did Dr. Rotem tell us this morning about how different the complexity of the Lake products are compared to Yonah?

A. So I think he said that -- it was him or somebody else, but the -- about a 20-fold difference in the number of

transistors. And whereas Yonah only came in one model with two cores -- there was one with one core, but it was just they turned one off -- with the Lake series processors, they can have two cores all the way up to I think it's 28 cores in the largest server products.

Q. Would you have expected the clock control techniques in Skylake to be different than the clock control techniques back in the day of Yonah?

A. Yes. Very much so.

Q. Why?

A. Well, I'll take the example if you have the 28 cores, if only one of them is doing some work, no matter what that one core does and how busy it thinks it is, it should not control everything else in the system. You need a system-level view of what's going on. And that's what SpeedStep brought to the table -- I'm sorry --

Q. Speed Shift?

A. -- Speed Shift, the new one.

Q. Thanks.

We'll just talk about Yonah when we're talking about --

A. Yeah. Yeah.

Q. -- SpeedStep to try and simplify things.

And so how different was Intel's 2015 Speed Shift clock control technology compared to the Yonah clock control technology from 2005?

01:51 A. It was very different.
01:51 Q. Now, one quick couple of questions.
01:51 To be clear, how many different modes of operation does Speed Shift have?
01:51 A. There's two. There's something called legacy mode and then autonomous mode.
01:51 Q. Which mode does VLSI accuse of infringing the '759 patent?
01:51 A. The autonomous mode.
01:51 Q. Is legacy mode accused?
01:51 A. No.
01:51 Q. So from now on when we talk about Speed Shift, we'll be talking about autonomous mode?
01:51 A. Yes.
01:51 Q. Okay. Now, where did the original ideas for Speed Shift come from?
01:51 A. From Dr. Rotem's research group, his thesis from that group.
01:51 MS. SOOTER: Let's take a look if we could at Exhibit D-36, please.
01:52 BY MS. SOOTER:
01:52 Q. Professor Grunwald, what is Exhibit D-36?
01:52 A. This is Dr. Rotem's Ph.D. thesis.
01:52 Q. Can you remind us what the date of his thesis was?
01:52 A. Yeah. August of 2014.

01:52 Q. And can you remind us generally what Dr. Rotem wrote his thesis about?
01:52 A. So it was basically on the power control for complex microprocessors, Speed Shift.
01:52 MS. SOOTER: Let's take a look at Exhibit D-35.
01:52 BY MS. SOOTER:
01:52 Q. Can you remind us what this document is, please?
01:52 A. Yes. This is another publication related to the outcomes of his thesis written with his thesis advisors.
01:52 Q. And who's the lead author there?
01:52 A. Dr. Rotem.
01:52 Q. What was the date of this publication?
01:52 A. I think this was 2016.
01:52 Q. And what's the general subject of this article?
01:52 A. So this is describing specific algorithms that Dr. Rotem studied and that were later implemented in Speed Shift.
01:53 Q. And what journal was this published in?
01:53 A. I think it was IEEE Computers. So this is a pretty broad -- like my undergrads and grad students would read this.
01:53 MS. SOOTER: For the next exhibit, I'd like to turn off the public monitors, please.
01:53 Could we take a look at Exhibit D-829? And we're going to go to Page 4.
01:53 BY MS. SOOTER:

01:53 Q. Professor Grunwald, what is this document?
01:53 A. So this is titled "Hardware P" -- oh, can I read the title?
01:53 Q. Sure.
01:53 A. Oh, "Hardware P-state and Intel Speed Shift Technology Algorithmic View."
01:53 Q. Who's the lead author on this document?
01:53 A. Dr. Rotem.
01:53 MS. SOOTER: Can we turn to Page 8, please? And I'd like to take a look at that figure, Figure 2, along with its label. Yeah.
01:53 BY MS. SOOTER:
01:54 Q. Generally, what does Figure 2 show?
01:54 A. This is an overview of the Speed Shift technology.
01:54 Q. What are the green boxes on the left generally?
01:54 A. They're the inputs into the algorithms on the right. So one box is labeled "Runtime telemetry," and the other one is labeled "Physical constraints."
01:54 Q. And what are the blue boxes on the right?
01:54 A. Those are just sort of the processing steps, the different algorithmic steps in the autonomous algorithms.
01:54 Q. Now, the top blue box says "Autonomous P-State Control."
01:54 Professor Grunwald, what does autonomous mean?
01:54 A. Well, autonomous, it has the same root as automatic.

So autonomous would mean automatic change. Think of it like an automatic transmission in a car.

Q. As opposed to?

A. Like a manual transmission.

Q. Now, where in Intel's processors do these algorithms run?

A. So these algorithms are implemented in the P-code that runs on the PCU.

Q. Now, Dr. Conte the other day referred to the PCU as kind of the brain. Do you remember that?

A. Yeah.

Q. And we've heard a lot of analogies to brains in this case, but do you agree with Dr. Conte that the PCU is kind of a brain for power control?

A. Yeah. It's a little computer inside the big computer that makes a lot of decisions for it.

MS. SOOTER: Let's go to our Slide 24, please.

BY MS. SOOTER:

Q. What do we see here?

A. So this is our illustration. The PCU's being represented by a brain, and the blue oval is representing the algorithms that were on the right-hand side in the Intel slide.

So these are the different autonomous algorithms, and there's a collection of them. I think Dr. Rotem mentioned, for example, the kick-down and H-EARtH and so forth.

01:55 Q. The H-EARtH, that's what we saw in Dr. Rotem's thesis and his article, right?
01:55 A. That's right. Yes.
01:55 MS. SOOTER: Let's go to Slide 25, please.
01:56 BY MS. SOOTER:
01:56 Q. What are the green folders around the PCU?
01:56 A. These are the inputs to the autonomous algorithms. So this is the stuff from the left-hand side, the green side of that previous Intel side, so the telemetry information as they call it.
01:56 Q. And if we go to Slide 26, what are the arrows coming out of the PCU?
01:56 A. So the autonomous algorithms run computations and eventually they determine what they call ratios, which then the ratios are sent to, for example, a clock generator or a PLL for a given part of the microprocessor.
01:56 So the ratios get communicated to the clock generators. And the ratios are all different from one another.
01:56 Q. The ratios are different from one another?
01:56 A. Yes.
01:56 MS. SOOTER: Let's look at Slide 27.
01:56 BY MS. SOOTER:
01:56 Q. What do we see here?
01:56 A. So this is attempting to illustrate the way that the Speed Shift algorithm works. So the clock control of the ring,

01:57 the clock control of the core, the clock control of the
01:57 graphics, they're all independent of one another. They're not
01:57 moving in lockstep, and there is no request mechanism as such.
01:57 Q. And was Speed Shift different from the clock control
01:57 that Yonah had used a decade or so earlier?
01:57 A. Yes. Very much.
01:57 Q. Now, can we turn to your noninfringement opinions?
01:57 A. Yes.
01:57 MS. SOOTER: Let's look at Slide 29, please. And we can
01:57 show this on the public monitor.
01:57 BY MS. SOOTER:
01:57 Q. What do we see here, Professor Grunwald?
01:57 A. So this is all the materials I considered when I went
01:57 through looking at the Speed Shift products. So I read the
01:57 '759 patent and then what's called the prosecution history that
01:57 we heard about earlier.
01:57 I read Speed Shift design documents, Speed Shift source
01:57 code. I spoke to some Intel engineers, and I read their
01:57 testimony.
01:57 I read Dr. Rotem's Ph.D. dissertation and related
01:57 articles, and then the expert reports of Drs. Conte and
01:58 Annavaram and then the trial testimony so far.
01:58 Q. That source code you mentioned, does that include the
01:58 source code we heard about earlier today that Mr. Borkowski and
01:58 his team wrote?

01:58 A. Yes.

MS. SOOTER: Now, the next slide I'd like to keep off of the public monitor, please, and talk about this at a high level. So if we could go to Slide 30.

BY MS. SOOTER:

Q. Generally what do we see here, Professor Grunwald?

A. So this is the file names and then sort of a rough explanation of what different collections of source code do. And it's based across two different family -- or two different products, Skylake, skl, and Skylake server, skx.

And the files on the top, the two -- the row on the top, are the source code files that make up the hardware. And then the file references on the bottom are the software. It's the P-code that runs on the PCU that uses the hardware to implement the autonomous algorithms.

Q. Is this all of the source code you reviewed or just a sample?

A. Just a sample.

Q. Okay.

MS. SOOTER: We can go to Slide 31 and show this on the public monitor?

BY MS. SOOTER:

Q. What products does VLSI accuse of infringing the '759 patent?

A. So they accuse the Intel Lake series, both the client

and the server microprocessors. So that includes: Skylake, Kaby Lake, Coffee Lake, Whiskey Lake, Cannon Lake, Amber Lake Comet Lake, Ice Lake, Tiger Lake in the client list. And then in the server list: Skylake, Cascade Lake and Ice Lake.

Q. Did you analyze the operation of all of these products?

A. Yes. I think, if I remember correctly, Tiger Lake was not -- had not been released to manufacturing at that time.

Q. But you still evaluated how it operated?

A. Yes.

Q. What did you conclude about whether all of those products or any of those products infringe the '759 patent?

A. None of them infringe the '759 patent.

Q. And do the reasons for noninfringement that we're going to talk about today apply to all of these products?

A. Yes.

MS. SOOTER: Let's take a look again at D-32, please.

BY MS. SOOTER:

Q. Once again, what is this?

A. These are the requirements of Claim 14.

Q. What is required, based on your understanding, to prove infringement of Claim 14, or any claim?

A. Well, for infringement a product has to practice or do every requirement.

Q. What if just one requirement is not met?

A. Then it's not infringing.

Q. How many reasons for noninfringement would you like to talk about today?

A. Just two.

Q. Please remind us the first reason that Intel's Lake series products don't infringe the '759 patent.

A. Well, so the first one is about requests.

MS. SOOTER: Let's go to Slide 33, please.

BY MS. SOOTER:

Q. Can you remind us where Claim 14 requires requests?

A. Yeah. So I'm going to spare reading through the whole thing again, but there is a first master device provided to -- sorry -- configured to provide a request to change a clock frequency.

There's a clock controller that receives the request provided by the master device.

And then the clock frequency of the high-speed clock, it outputs as a -- in response to receiving the request provided by the first master device for both the second master device and the variable speed clocks.

Q. Okay. So let's break that down just a bit. Looking at 14[B], starting in the first line, it says first master device, right?

A. Yes.

Q. So in 14[B] -- according to 14[B], what is configured

to provide a request?

A. The first master device must be -- or is -- the first master device configured to provide a request to change a clock frequency.

Q. And looking at 14[E], what -- and [D], what receives the request?

A. A programmable clock controller having an embedded computer program therein, the computer program including instructions to receive the request.

Q. So in Claim 14 a first master device provides a request, and a programmable clock controller receives a request?

A. Yes.

Q. Let's look at Slide 34.

Do all of the claims we're going to talk about require these requests?

A. Yes. It's worded a little bit differently in Claim 18, but it's the same concept fundamentally.

Q. And looking at 18[F] [sic], what in the claim must be configured to receive the request? 14[F].

A. Oh, 14[F].

Q. Sorry.

A. Sorry. A second master device coupled to the bus in response to receiving the request.

Q. Well, in 14[F] does the clock controller -- is a

clock controller configured to receive the request?

A. Yes.

Q. Sorry. For 18[F]. That's my fault. I've got you all confused.

A. That's what I was wondering.

Q. My bad. So under 18[F] the clock controller is configured to receive the request, right?

A. That's right.

Q. My fault.

And 18[G], what sends the request?

A. The request is sent from the first master device in response to the predefined term.

Q. So both claims require a first master device sending a request and a clock controller receiving a request, right?

A. Yes, that's right.

Q. Does Intel Speed Shift feature meet these request requirements?

A. No.

Q. Instead of using requests, how does Speed Shift go about changing the clock frequency?

A. It uses these autonomous algorithms.

Q. And what did Dr. Rotem tell us about whether or not Speed Shift uses requests to change the clock frequencies in the way the claims -- sorry. I'll stop there.

What did he tell us about whether or not the Lake products

use requests?

A. He said that they didn't use requests to change the clock frequencies.

Q. What type of algorithms did he say they use instead?

A. The autonomous algorithms using telemetry information.

Q. What type of technique did Mr. Borkowski say that Intel's Lake products use to change the clock frequencies?

A. The autonomous algorithms that he implemented in P-code.

Q. Did you review Intel's technical documents during your noninfringement analysis?

A. Yes, I did.

MS. SOOTER: Let's take a look at Exhibit D-254, please.

BY MS. SOOTER:

Q. Professor Grunwald, what is this document?

A. This is a presentation of -- introducing Skylake at the Intel Developer's Forum.

Q. And who wrote this presentation?

A. Dr. Rotem.

Q. And when does it appear that this presentation was given?

A. In 2015.

Q. Was that before or after VLSI sued Intel for infringement?

02:05 A. Well before.
02:05 Q. And who would the audience have been at a presentation like this?
02:05 A. Both system designers, so people from Dell or Compaq or IBM who make equipment or laptops, and then software developers, software engineers, a variety of people.
02:05 MS. SOOTER: Let's take a look at Slide 21, please.
02:05 BY MS. SOOTER:
02:05 Q. And there's a diagram on the top. It says "Autonomous Algorithms -- High Range." Can you describe to us what we're seeing there?
02:05 A. Yeah. So this is illustrating basically the innovation and Dr. Rotem's thesis work, sort of what the upshot of it was.
02:06 So the idea here is that you want to be able to trade off energy, like battery lifetime for performance with a controllable knob from the user to say what do I prefer to have?
02:06 And then given those preferences and then what's happening on the cores, it can find a most efficient clock frequency to run at at the current time.
02:06 Q. Where do we see that most efficient clock frequency on this graph?
02:06 A. That's this yellow dot -- that's sort of in the sweet spot of this performance energy curve.

02:06 Q. And again, which part of the processor determines that optimum clock frequency?

02:06 A. It's the autonomous algorithms running on the PCU.

02:06 MS. SOOTER: Let's take a look at Exhibit D-831, and I'd like to turn the public monitors off again, please.

02:06 BY MS. SOOTER:

02:07 Q. Professor Grunwald, what is this document?

02:07 A. So this is -- it says "Skylake Server Hardware P-State High-Level Architectural Specification."

02:07 Q. And again, what's the date of this document?

02:07 A. December 2014.

02:07 Q. Before or after VLSI sued Intel?

02:07 A. Well before.

02:07 MS. SOOTER: Let's take a look at Page 34, please.

02:07 BY MS. SOOTER:

02:07 Q. Now, what is Section 4 talking about?

02:07 A. It's talking about the autonomous algorithms that were implemented in the server products. The server products had different algorithms, or could have different algorithms, than the mobile or client products.

02:07 Q. Generally, what does this tell you about how Speed Shift controlled the clock frequency of the different components?

02:07 A. Well, that it used these autonomous performance selection algorithms.

Q. Were there other Intel documents and information that you considered?

A. Yes.

MS. SOOTER: Let's turn to Slide 35, please.

BY MS. SOOTER:

Q. What do we see here?

A. This is a -- snippets from different documents discussing the fact that they all use autonomous P-state control for autonomous algorithms, that's in Skylake and all the following processors.

Q. And what did you conclude about how Speed Shift controls clock speed?

A. Well, that it's a -- autonomous -- it's not using requests for that.

Q. Now, to be clear, you reviewed a lot of Intel documents and information including source code, right?

A. Yes.

Q. And from time to time did you see the word "request"?

A. Yes. It was -- it appeared often, in part because of the legacy P-states that is not infringing, apparently. So that had a request mechanism.

Q. And request is a common word anyway, right?

A. Yes. That too.

Q. And did you take all of those documents into account when you were forming your opinions?

A. Yes.

Q. In Speed Shift, based on all of your analysis, did you find that there was any request to change a clock frequency sent by a master device and received by a clock controller?

A. No.

Q. And to be clear, VLSI's expert is Dr. Conte, right?

A. Uh-huh.

Q. And what does Dr. Conte say is the master device in Speed Shift?

A. He identified the cores as the master device.

Q. And what does Dr. Conte say is the clock controller?

A. The PCU.

Q. Did you find any indication in Speed Shift that there is a request provided by a core and received by the PCU to change a clock frequency of a high-speed clock?

A. No.

Q. And while we're on this Slide 35, which exhibits are these that you considered that you've mentioned showing autonomous?

A. Yeah. So Exhibit PTX-1696 in the upper left corner, Exhibit D-829 below that, D-840, D-26 below that. And then in the next column was D-833, D-254 and D-831.

Q. Thank you.

Professor Grunwald, were you here for Dr. Conte's -- or did you hear Dr. Conte's testimony about the '759 patent?

A. Yes. I heard his testimony.
Q. And do you recall that Dr. Conte says that a change to the Core_Active signal is a request as the claims require?
A. Yes.
Q. Do you agree or disagree with Dr. Conte?
A. I disagree.
Q. First of all, what is a Core_Active signal?
A. So it's a wire that comes out of the core, is the way to think of it. And it's either a zero or a one. So like one, the core is active, it's powered on. At zero, the core is asleep, it's inactive. And at any time interval it's just telling you whether the core is active or asleep.
Q. And let's take a look at Exhibit -- sorry -- Slide 36, please.
If you were to draw the Core_Active signal on this illustration, where would it be? I don't know if your screen will allow you to do that. We don't see it if you're --
A. Is it not coming through?
Q. No. Is it for you?
A. No. So it comes from this --
Q. Oh, I can see it over there. Okay. Good.
A. Okay. So basically the Core_Active is feeding into another unit, and that other unit observes it like a -- you know, a few million times a second. And when it sees that the Core_Active is up when it's looking at it, it increments a

counter. That counter is what the C0 residency is.

Q. Is the Core_Active signal an input to the autonomous algorithms that calculate the clock speed ratios?

A. No.

Q. Is the Core_Active signal a request to change the clock frequency of a high-speed clock?

A. No. By the time the Core_Active changes, the clock frequency's already changed, from on -- or off to on.

Q. Were you here when Dr. Conte said that even if Speed Shift doesn't literally have a request, it has something equivalent to a request?

A. Yes.

Q. And do you recall that Dr. Conte pointed to some calculations performed within the PCU as requests?

A. Yes, I do.

MS. SOOTER: Can we bring up Dr. Conte's Slide 207?

BY MS. SOOTER:

Q. I'd like to focus in on the right-hand part of this slide, please. My first question is this: On Dr. Conte's slide, have you ever seen this diagram in Intel's documents as it's shown here?

A. No. I believe that this diagram was invented by Dr. Conte for this trial.

Q. Now, he points to something that he calls a calculated speed change as a request. Do you see that?

A. Yes.

Q. Does this calculated speed change work in the same way or a different way than the '759 claims require?

A. It works in a different way.

No -- I'm sorry. Never mind.

Q. Is the calculated speed change sent from a core to a PCU?

A. No. It's not.

Q. Where does it come from?

A. It's calculated by the code that the autonomous algorithms are running on the PCU.

Q. So can that calculated speed change be the request required by the claims of the '759 patent?

A. No.

Q. Can it be equivalent to what the claims require?

A. No.

Q. Now, did the original patent owner say anything to the Patent Office on this issue of the Doctrine of Equivalents?

A. Yes.

MS. SOOTER: Let's take a look at Slide 37, please.

BY MS. SOOTER:

Q. Now, I believe we heard from Dr. Conte the other day about something called the prosecution history of a patent. Do you remember that?

A. Yes.

Q. And that's a back and forth between the patent applicant and the Patent Office, right?
A. That's right.
Q. In this case was the patent applicant VLSI or someone else?
A. It was someone else. It was the prior patent owner.
Q. Now, I have -- we're looking here at Page 224 of Exhibit D-249. What do we see here?
A. So the -- over the lifetime of the patent prosecution, the claims were rejected seven different times, and so each time the patent applicant had to come back and narrow, refine or argue with the patent examiner. This is the patent applicant's explanation of why its claims should be allowed.
Q. So the prior patent owner wrote this?
A. Yes. The prior patent owner wrote this.
Q. And what is the date of what they wrote?
A. September 17th of 2007.
Q. What did the prior patent owner say first?
A. Well, so they -- the office, the Patent Office, Patent Office action contends that Ansari, the previous work that the Patent Office had mentioned, discloses a master device making a request.
Q. What did the prior patent owner say second?
A. So they said: "Applicants respectfully disagree with

this conclusion."

Q. And what did the prior patent owners say third?

A. So in order to differentiate themselves, they're saying: "The reference does not specify that the master device identifies an appropriate frequency. The reference instead teaches that the bus arbiter selects the frequency based on a number of factors, including the nature of the transaction."

Q. What does this tell us about whether Dr. -- what Dr. Conte says are equivalent to the requests are substantially the same or substantially different than the claimed requests?

MR. CHU: Objection. It's prosecution history estoppel.

It is a decision for the Court as well as claim construction.

THE COURT: Can I hear the question again?

MS. SOOTER: What does this tell us about whether what Dr. Conte says is equivalent to the claimed requests are substantially the same as what the claims require or substantially different from what the claims require?

THE COURT: I'm going to sustain the objection with the way you phrased that question, in terms of the general question about: What does this tell you. If you have a more specific question, I'm happy for you to try it.

BY MS. SOOTER:

Q. Is Dr. Conte's opinion about the equivalent calculations in the PCU, or the calculations in the PCU being

equivalent to what the claims require consistent with what the prior patent owner said or inconsistent with what they said?

MR. CHU: Same objection. It's arguing patent prosecution estoppel.

THE COURT: And my concern, I guess, wasn't clear enough. You've given him a long passage.

MS. SOOTER: I see.

THE COURT: Is there a specific portion of this you wanted him to address? That's what I'm concerned about.

MS. SOOTER: Sure. Yes. Thank you, Your Honor.

THE COURT: So I'll sustain the objection.

MS. SOOTER: Okay.

BY MS. SOOTER:

Q. So if you look at No. 3, No. 3 says, "The reference." That's going back to the Ansari prior art patent reference, right?

A. Uh-huh.

Q. That old reference does not specify that the master device identifies an appropriate frequency, right?

A. Right. That's the distinction they were drawing.

Q. Because the old reference did not specify a master device identifies an appropriate frequency, they were distinguishing a prior art, right?

A. That's right.

Q. Now, focusing in on that passage, is what Dr. Conte

argues about the calculations being equivalent to what the claims require consistent or inconsistent with what the prior patent owner said?

MR. CHU: Objection. It's basically asking the witness to venture an opinion on prosecution history estoppel and claim construction which is the province of the Court, not of the witness.

THE COURT: I'll sustain it.

BY MS. SOOTER:

Q. Now --

THE COURT: I'll sustain it as the way you phrased it.

MS. SOOTER: I'd like to actually seal the courtroom for just a moment if I may or --

THE COURT: Of course.

MS. SOOTER: Okay.

THE COURT: Is there anyone -- let me ask before you move forward.

Is there anyone in the courtroom who's not under the protective order? And we'll turn off the public feed.

MS. SOOTER: Thank you, Your Honor.

(Sealed proceedings.)

BY MS. SOOTER:

Q. Professor Grunwald, does Speed Shift meet the request requirements of Claims 14 and 18?

A. No.

02:25 Q. And what does that mean, going to Slide 39, for infringement?

02:25 A. So that means by itself by that reason alone, the Skylake products don't infringe.

02:25 Q. So could we stop there and show noninfringement?

02:25 A. Yes.

02:25 Q. Do you have a second additional reason?

02:25 A. Yes.

02:25 MS. SOOTER: Let's go to Slide 40, please.

BY MS. SOOTER:

02:25 Q. Can you remind us which parts of the claims you refer to as the common control requirements?

02:25 A. Yeah, so that's 14[F] and [G] and corresponding things in 18. So that's this phrase: "Provide the clock frequency of the high-speed clock as an output to control a clock frequency of a second master device and then of a variable clock frequency of the bus."

02:26 Q. Taking a look at Slide 41, do all of the claims have a common control requirement?

02:26 A. Yes. In 18 it's phrased a little bit differently.

02:26 Q. Does Speed Shift meet the common control requirements of the claims?

02:26 MR. CHU: Excuse me, Your Honor. I object to the prior question or two. It was claim construction. It was the imposition by the witness, with the witness' lawyer, trying to

impose a common clock requirement in the claim.

THE COURT: Okay. Well, the one -- questions have been asked and answered will stand. But I didn't hear all of the counsel's question that time. So if I could hear the question again, that would help.

MS. SOOTER: Yes, Your Honor. Maybe I could back up a couple steps?

THE COURT: Okay.

BY MS. SOOTER:

Q. Okay. So, Professor Grunwald, did you apply the full language of Elements 14[F] and 14[G] in your analysis?

A. Yes. I did. Particularly along with 14[B] as well.

Q. And did you also apply the full language of Claim 18?

A. Yes. I did.

Q. And do you have just a shorthand way of referring to Elements 14[F] and 14[G] in Claim 14?

MR. CHU: Objection. I am anticipating the answer from the prior Q and A because that's what he said. He basically said that those provisions, F and G, as an example, were a common clock requirement. Common clock appears nowhere in either of the claims.

THE COURT: Okay. Well, let's hear his answer. And if you want me to strike his answer after he gives it, I'll consider it. I'm not prejudging. But if you'll ask the question, Doctor, you can answer, and then I'm not going to

prejudge what his answer's going to be.

BY MS. SOOTER:

Q. And, again, as just a shorthand way of referring to the exact language that's in the claim, without attempting to inject anything, how do you refer to Elements 14[F] and 14[G]?

A. It's using the phrase "common clock," the -- because "the clock frequency of the high-speed clock has an output to control" is a mouthful.

MR. CHU: I move to strike.

THE COURT: I'll overrule your -- I'll overrule the objection.

MR. CHU: Okay. If there are similar questions -- obviously, if there are different questions, I'll interpose a new objection. But if there's a series of similar questions, can I have a running objection --

THE COURT: Of course.

MR. CHU: -- so as not to interrupt?

THE COURT: Yes, sir.

MR. CHU: Thank you.

BY MS. SOOTER:

Q. Does Speed Shift -- Intel's Speed Shift feature meet the requirements of the claims that we're calling, just by using the shorthand phrase, "common control"?

A. No. It has separate clock frequencies of high-speed clocks.

02:29 Q. How would you describe the clock control within Speed Shift?

02:29 A. I mean, I would use the phrase "independent clock control."

02:29 MS. SOOTER: Let's take a look at Slide 42, please.

02:29 BY MS. SOOTER:

02:29 Q. Where do we look to see whether or not the claim requirements 14[F] and [G] and 18[E], the common control requirements as we're calling them for short, are satisfied by Speed Shift?

02:29 MR. CHU: Objection, Your Honor. It's now become the "common control requirement." It doesn't fix it by just saying, "We're calling it for short." It is changing the construction of the claim.

02:30 THE COURT: Counsel?

02:30 MS. SOOTER: We are absolutely not intending to do that, Your Honor. It's just a shorthand way of referring to the precise language as written in the claims.

02:30 THE COURT: And how does that compare to any claim term that I construed?

02:30 MS. SOOTER: We're not substituting any construction for it, Your Honor. We're just -- it's a lot of words in 14[F] and 14[G].

02:30 MR. CHU: Your Honor, there was no claim construction of a common clock. And counsel is calling it "a common clock

requirement" and then adds the words "for shorthand." The adding of the word "shorthand" doesn't change the nature of the question or the answers. It ends up being claim construction.

MS. SOOTER: Your Honor, we are applying the plain and ordinary meaning of the claims as written, and we'd be happy to, and we will, go through that language in detail.

THE COURT: I'll overrule the objection.

BY MS. SOOTER:

Q. Now, looking -- where do we look on Slide 42 to see whether or not Speed Shift works the way the claims require?

A. So if you recall, the autonomous algorithms, they use the telemetry information to compute different ratios that are sent to the PLLs or clock generators for the different parts of the processors.

And the PLLs -- the values of the PLLs can be different, and so the clock frequencies that they provide to the different elements are independent of one another.

MS. SOOTER: Can we take a look at Slide 43, please?

BY MS. SOOTER:

Q. What do the moving bars on the right-hand side represent?

A. They're illustrating that, for example, the clock frequency of the graphics unit is independent of the clock frequency of the core, for example.

Q. Now, what did Dr. Rotem say about how Speed Shift

controls clock frequencies?

A. He said that there are separate PLLs that provide independent frequencies.

Q. And what did Mr. Borkowski say about whether Speed Shift controls -- how Speed Shift controls the clock frequencies?

A. He said that code that he wrote produces separate ratios that then drive the clock frequencies.

Q. Did you consider any Intel documents when analyzing these parts of the claim?

A. Yes.

MS. SOOTER: Let's take a look at Exhibit D-254, please.

BY MS. SOOTER:

Q. This is that same presentation by Dr. Rotem, right?

A. Yes.

MS. SOOTER: Can we go to Page 6 this time, please?

BY MS. SOOTER:

Q. What do we see here?

A. So this is sort of high level view of the power management and clocks in the Skylake.

Q. And looking at the second to the last bullet, it says, "Independent frequencies for ring, PG slice & logic." Do you see that?

A. Yes. I do.

Q. Now, what does Dr. Conte say is the bus required by

the claims?

A. The ring. He says the ring is the bus.

Q. And what does Dr. Conte say is the first master device -- second master device required by the claims?

A. One of the cores of the logic.

Q. And what does this tell us about how those different parts of the device are controlled?

A. That they have independent frequencies for each of the parts.

MS. SOOTER: Let's take a look at Exhibit D-255, please, and we'll need to turn the public monitors off, please.

BY MS. SOOTER:

Q. And if we could -- well, first of all, what is this?

A. So this is the Skylake client clock HAS or high level architectural specification.

Q. And what's the date?

A. Oh, sorry. 2013.

Q. Before or after VLSI sued Intel?

A. Again, well before.

MS. SOOTER: So could we turn to Page 18, please?

BY MS. SOOTER:

Q. At the top of Section 3.1.3, the document says, "SKL supports independent core, ring/LLC/CBo frequency and voltage."

Do you see that?

A. Yes.

02:34 Q. And again, what does Dr. Conte say is the second master device?
02:34 A. The cores.
02:34 Q. And what does he say is the bus?
02:34 A. The ring.
02:34 Q. And what does this document tell us about how Skylake controls the clock speeds of the core in the ring?
02:34 A. That they're independent, so there's two different PLLs or clock generators for those two parties.
02:34 Q. Did you see any other documents confirming your analysis?
02:35 A. Yes.
02:35 MS. SOOTER: Let's take a look at Slide 44, please.
02:35 BY MS. SOOTER:
02:35 Q. What do we see here? And maybe we could mention the exhibit numbers.
02:35 A. Yeah. So Exhibit D-254 talks about "independent frequencies for ring, PG, and slice."
02:35 D-840 talks about starting with Haswell and then following it, "Uncore frequency can be changed independent of core frequency." So that's all the Lake series.
02:35 "Uncore frequency," which means everything other than the core, including the mesh, "frequency can be changed independent of core frequency," in D-857.
02:35 D-255 says, "Skylake supports independent core,

ring/LLC/CBo," and "independent core and ring and uncore frequencies."

D-465 discusses independent -- changing the clock frequency "of the individual Cores and Uncore interconnect, independent of each other."

So they're all discussing about independent frequencies.

MS. SOOTER: Let's go back to Slide -- or go to Slide 45, please.

BY MS. SOOTER:

Q. How does Speed Shift's independent clock control compare to claim requirements 14[F] and 14[G] and 18[F] -- [E]? Sorry.

A. So 14[F] and 14[G] require the high-speed clock of the -- sorry -- the output of -- the high-speed clock as an output of the master clock controller, from 14[B], to "provide the clock frequency of the high-speed clock as an output to control a clock frequency of a second master device." And then that same, "provide the clock frequency of the high-speed clock as an output to control the variable clock frequency of the bus."

And then similarly in 18, "the clock controller configured to output a clock frequency of a high-speed clock to control the variable clock frequency of the bus and to control the clock frequency of a second master device."

MR. CHU: I interpose an objection. In the middle of the

02:37 answer the witness slipped in language that is not in the
02:37 claims, namely, "that same" -- "that same, provide the clock
02:37 frequency of the high-speed clock," going back to the common
02:37 clock concept.
02:37 It was in the middle of the answer. I could not have
02:37 known that from the question itself. He started out reading
02:37 the claim language and then shifted.
02:37 MS. SOOTER: I can ask a question to follow up and
02:37 clarify.
02:37 THE COURT: Okay.
02:37 BY MS. SOOTER:
02:37 Q. Professor Grunwald, does 14[F] start by saying
02:37 "provide the clock frequency of the high-speed clock"?
02:38 A. Yes. It does.
02:38 Q. And what language does 14[G] start with?
02:38 A. "Provide the clock frequency of the high-speed
02:38 clock."
02:38 Q. Is that language in 14[F] that we just referred to
02:38 the same or different than the language in 14[G]?
02:38 A. It is the same.
02:38 Q. Is that what you meant?
02:38 A. Yes.
02:38 MS. SOOTER: Let's go to Slide 46.
02:38 BY MS. SOOTER:
02:38 Q. Does Speed Shift meet these requirements?

02:38 A. No.
02:38 Q. Now, does Dr. Conte agree that the claims require common control?
02:38 A. No.
02:38 MS. SOOTER: Let's take a look at Slide 48.
02:38 BY MS. SOOTER:
02:38 Q. How does Dr. Conte read the claims?
02:38 A. In Dr. Conte's testimony he described the clock frequency of the high speed -- sorry -- a separate or different clock frequency at a high-speed clock driving the bus.
02:39 Q. Do you agree?
02:39 A. I disagree.
02:39 MS. SOOTER: Let's go to Slide 49. Oh, sorry. I wanted to go to 47. My fault.
02:39 BY MS. SOOTER:
02:39 Q. Now, let's look at 14[B]. What does that bold language require?
02:39 A. So in 14[B] it -- "provide a request to change a clock frequency of a high-speed clock."
02:39 Q. And what does 14[F] require providing in response to receiving the request?
02:39 A. "The clock frequency of the high-speed clock."
02:39 Q. What does --
02:39 A. The same clock frequency of a high-speed clock discussed in 14[B].

MR. CHU: Objection. The --

THE WITNESS: Sorry. Same words.

MR. CHU: Excuse me, Your Honor. And I apologize, Doctor. I'm sure you understand that a lawyer has to make an objection.

He just interposed the words -- he started out reading the claim language and then he interposed the words "the same" in there. And the words "the same" don't appear there, just the -- just as the word "common clock" does not appear in the claims.

THE COURT: The jury has the claims he's reading from, correct?

MS. SOOTER: Yes.

THE COURT: Okay. I'll overrule the objection.

BY MS. SOOTER:

Q. And how does the bolded language in 14[G] compare to the bolded language in 14[F]?

A. It uses the same words.

Q. So, Professor Grunwald, are you ignoring any of the claim language in your analysis?

A. No, I'm not.

Q. Are you inserting any new claim language in your analysis?

A. No, I'm not.

Q. Do you remember when Dr. Conte testified the other day that you were misreading the claim language?

A. Yes. That's correct.
Q. Do you agree or disagree?
A. I disagree.
Q. How are you reading the claims as compared to how they're written?
A. As a person of ordinary skill in the art.
Q. And are you being true to the claim language?
A. Yeah. True to the claim language. I mean, I'm just reading the words as they are presented in the claim.
Q. Okay.
MS. SOOTER: Now, if we could look at Slide 49, please.
BY MS. SOOTER:
Q. Going back to the prosecution history between the original patent owner and the Patent Office, on December of 2008, was there a '759 patent yet?
A. No, there wasn't.
Q. And in this previously pending claim, what did that bolded or yellow requirement at the end say?
A. It said "control the clock frequency of the bus in response to receiving the request provided by the master device."
Q. Did it say anything about controlling the clock frequency of a second master device?
A. No.
MS. SOOTER: Let's go to Slide 50, please.

02:42 BY MS. SOOTER:

Q. What happened on June 25, 2009 before the patent issued?

A. The claim on the left was rejected because it was not -- if I remember, not novel, and it had to then be narrowed or refined for the patent to continue.

Q. Once the claim was amended on June 25, 2009, what did the yellow language say about an output to control a clock frequency of a second master device?

A. It said, and I'll read the whole thing just to avoid concerns. "Provide the clock frequency of the high-speed clock as an output to control a clock frequency of a second master device coupled to the bus in response to receiving the request provided by the first master device; and provide the clock frequency of the high-speed clock as an output to control the clock frequency of the bus in response to receiving the request provided by the first master device."

Q. And do the claims that ultimately issued require provide the clock frequency of the high-speed clock as an output to control a clock frequency of a second master device, et cetera, and provide the clock frequency of the high-speed clock as an output to control the clock frequency of the bus?

A. Yes.

MS. SOOTER: Let's look at Slide 51.

BY MS. SOOTER:

02:43 Q. Can you please summarize the claim requirements that are not met by Intel's Lake series processors?

02:43 A. So the claims 14[F] and [G], and then 14[E] are not met by the Lake series.

02:44 Q. Looking at Slide 52, what do we see here?

02:44 A. So again, this is just an illustration showing on the left-hand side the way that Speed Shift operates. So the clock frequency of the ring and the clock control of the core, the clock control of the graphics are independent of one another.

02:44 And on the right-hand side is what the plain wording of the '759 patent requires, that there is a clock frequency to change -- a request to change a clock frequency. And then based upon that request, the long phrase of clock frequency of, so on and so forth.

02:44 Q. Is Speed Shift's clock control the same or different from what the '759 patent requires?

02:44 A. It's different.

02:44 Q. Let's look at Slide 53. Do Intel's products with Speed Shift infringe Claims 17 or 24?

02:44 A. No. Because Claims 14 and 18 don't hold, then these two don't hold for the Lake products.

02:45 Q. And why not?

02:45 A. Because the first clause is basically saying include all of the requirements from Claim 14, or include all the requirements from Claim 18. And since they're not met in 14

and 18, they're not met here.

MS. SOOTER: Let's go to Slide 54 and go back to our timeline.

BY MS. SOOTER:

Q. Now, can you remind us what products we were just talking about with regard to infringement and noninfringement?

A. The Lake series products, the newer ones.

Q. And what date do we have to look at to evaluate the invalidity of the patent?

A. Before June 29, 2005.

Q. And can you remind us what product you looked at?

A. The Intel Yonah processor.

Q. And what did you find?

A. That Intel Yonah -- the Yonah invention is prior art for the '759 patent.

MS. SOOTER: Let's take a look at Slide 55.

BY MS. SOOTER:

Q. What do we see here?

A. So these are some of the materials I considered. So various Intel -- or sorry -- Yonah design documents, Yonah specifications, Yonah presentations, Yonah source code, Intel patents related to Yonah, Intel engineer interviews and testimony, publications related to Intel's Yonah processor and then trial testimony.

MS. SOOTER: If we could show Slide 56 but not on the

public monitors.
BY MS. SOOTER:
Q. Can you just summarize at a high level what we see here?
A. So these are different source code files. So I'll just read the exhibits.
So D-947, D-965, D-966. So again, these are all sort of hardware definition files.
D-967, D-961. Later it talks about receiving a clock frequency request from a core. That's D-948 to D-949, D-91113 through D-91117 [sic].
And then writing frequency to request to registers, so that's what's called microcode, that's D-950. And then there's more hardware code about controlling a single clock generated, that's D-949, D-957 through D-964. And then clock frequency algorithms, that's D-955 through D-956.
Q. Great.
MS. SOOTER: Let's go to Slide 63, and we can go ahead and show these on the public monitors -- oh, no. We can't. Sorry. We have to keep these down.
BY THE WITNESS:
A. I forgot something on the previous slide.
BY MS. SOOTER:
Q. Oh, sure. Go ahead.
A. Could you go back?

02:47 Q. 56.

02:47 A. Yeah. I just wanted to point out: All of these files are from what's called the B0 stepping of the Yonah processor. And that stepping was manufactured in April of 2005. I just wanted to say which versions of the files this was.

02:48 Q. Right. And that was before the '759 patent?

02:48 A. That was before the '759 patent.

02:48 Q. Great.

02:48 MS. SOOTER: Let's go ahead and look at Slide 63, please.

02:48 BY MS. SOOTER:

02:48 Q. Can you just generally walk us through the timeline at a very high level as to the development of the Yonah product?

02:48 A. Yes. So the product started, I think, engineering ramp-up or design work in very early 2001, and it increased through 2002. Work on the design increased through 2004 -- or sorry -- '3 and '4.

02:48 They fabricated parts, I believe, in the last quarter of 2004. They demonstrated them in March 2005. And they shipped them to various manufacturers, so, you know, the Dells and IBMs of the world and so forth, in the last quarter.

02:48 And then there was the B0 stepping, the one that I looked at, was from April 2005.

02:49 MS. SOOTER: And for the record, the Yonah staffing

ramp -- I think we've seen this document today, was D-557. And the document associated with October 2004 was D-294.

BY MS. SOOTER:

Q. Sir, what is the picture that we see associated with the March 2005 date in Exhibit D-296?

A. So that's an image from the Intel Developer's Forum. So Intel does sort of a reveal for fans of systems early on, and that was the first public demonstration of the Yonah to the customer -- or, you know, the public.

Q. Based on the research you did, did that have an operating system installed on it?

A. Yes. Based on the image in the slide, the background that's running the Windows operating system.

Q. Great.

MS. SOOTER: Let's take a look at Exhibit D-284.

BY MS. SOOTER:

Q. What is this document?

A. This is the Intel Technical Journal, so this is like an academic journal, but it comes from Intel. And it gives their engineers an opportunity to do a comprehensive description of their designs and products and the novel things that are in them.

Q. Does it describe how Yonah's clock control worked?

A. Yes. This article "Power and Thermal Management" does that.

02:50 MS. SOOTER: Can we look at Page 35 of the PDF, I think? I'd like to look at the paragraph on the bottom left that starts with "consequently."

BY MS. SOOTER:

Q. See the second sentence there that says, "As with the C-state mechanism, each core's OS power management component can request a P-state"?

A. Yes. Separately via standard, what's called an MSR, a model-specific register.

Q. What does that tell you about the clock control in Yonah?

A. That the OSPM, you could write into this hardware register, this MSR, and then change the clock speed.

Q. And where was the OSPM running according to this sentence?

A. On the cores.

MS. SOOTER: Let's go back to our timeline. And let's go to Slide 64.

BY MS. SOOTER:

Q. Was Yonah a successful product?

A. Very successful. So Yonah was actually the reason that Apple switched from the kind of CPUs they used before to Intel products. And this was the first Apple MacBook that used the Yonah processor.

MS. SOOTER: Let's go to Slide 65.

BY MS. SOOTER:

Q. And can we talk about how Yonah's clock control worked?

A. Yeah. So in Yonah the operating system executing on the cores would make a request through this OSPM mechanism. They would write this model-specific register. That request then is communicated -- and there's some other parts called microcode that get involved -- it's communicated to a clock controller to increase or decrease the clock frequency.

And then that changes the clock frequency of the PLL, and then that same clock frequency is provided to Core 2, Core 1 and to the bus.

MS. SOOTER: Let's look at Slide 66, please.

BY MS. SOOTER:

Q. Back to Claim 14. Now, Professor Grunwald, what did you do to determine whether the '759 patent claims were valid?

A. I looked at the invention of Yonah and went then element by element.

Q. And can we do that together?

A. Yes.

MS. SOOTER: Let's look at Slide 67.

BY MS. SOOTER:

Q. Starting with 14[A], did Yonah already include a bus before the '759 patent?

A. Yes, it did.

02:53 Q. Where do we see that on Exhibit D-33?
02:53 A. It's the thing labeled "bus."
02:53 Q. B-u-s, right in middle?
02:53 A. Yes.
02:53 Q. All right. Did -- continuing to look at the same exhibit, and we're on Page 36 of that exhibit, did Yonah already include a first master device coupled to the bus?
02:53 A. Yes, it did.
02:53 Q. And where do we see that?
02:53 A. Each of these cores is a master device. And they are coupled to the bus because that's what they use to communicate with each other, and then with the memory and then off the chip if they need to.
02:53 Q. Was the bus in Yonah capable of running at a variable clock frequency?
02:53 A. Yes, because the whole processor would run at variable clock frequencies.
02:53 Q. So did Yonah already have what 14[A] requires?
02:53 A. Yes.
02:54 MS. SOOTER: Let's go to Slide 68.
02:54 BY MS. SOOTER:
02:54 Q. What does Exhibit D-31 tell us about whether Yonah had a first master device configured to provide a request to change a clock frequency of a high-speed clock?
02:54 A. It did. So it says here the OS, the operating

system, so, you know, Windows or Mac OS or Linus, tracks the workload on each processor and makes GD3 requests, so GD3 stands for Geyserville 3. That's their code name for making clock requests, and it says it seeks to get to 100 percent utilization, wants the CPU to be busy.

Q. Looking at the rest of 14[B], did Yonah provide these requests in response to predefined changes in performance of the first master device?

A. Yes. It does.

Q. Let's look at Slide 69, please.

And what do we see at the top left in D-296?

A. So this is that photo from the Intel Developer Forum's booth, and this was on a public website and they were demonstrating Yonah.

So the chip would be here and this is a test motherboard and it's running. You can see the Windows user interface in the back.

Q. Let's -- and just to be clear, where on Yonah did the operating system run?

A. On the cores.

Q. So did Yonah already include what's required in 14[B]?

A. Yes.

MS. SOOTER: Let's go to Slide 70, please.

BY MS. SOOTER:

02:55 Q. Did Yonah already include what's required by 14[C]?
02:55 A. Yes. So 14[C] is: "Wherein the predefined change in performance is due to loading of the first master device as measured within the predefined time interval."
02:55 And in their case just like in the paper that I had done in the year 2000, they use the operating system to be able to detect loading and then to make those requests.
02:56 Q. So did Yonah already have what's required in 14[C]?
02:56 A. Yes.
02:56 MS. SOOTER: Let's go to Slide 71.
02:56 BY MS. SOOTER:
02:56 Q. What component does 14[D] and 14[E] require?
02:56 A. I think we saw sort of a sideways view of this before, the PML. So this is some hardware logic that when an individual core receives a request from the model specific register, the micro-code does some things and it eventually goes into this clock control register here.
02:56 So these are then for each core for that. And then this logic helps determine what the final resulting clock frequency should be.
02:56 Q. Thank you. And I want to just clarify that in connection with 14[A] and 14[B], were you talking about Exhibit D-31?
02:57 A. Yes.
02:57 Q. And with regard to element 14[C], were you talking

about Exhibit D-32?

A. Yes.

Q. And which exhibit do we see here on Slide 71?

A. D-267.

Q. And does Yonah have a -- did Yonah have before the clock, '759 patent, a programmable clock controller?

A. Yes. This is part of it.

MR. CHU: Objection, Your Honor. This was an issue that we discussed before. He started -- by the time I heard the question, he started to answer.

Objection, Your Honor. My microphone was off. Did you hear my objection?

THE COURT: I only heard your objection that was something we discussed before.

MR. CHU: Yes.

THE COURT: And I didn't learn that objection in law school so you're going to have to help me a little bit.

MR. CHU: It had to do -- sorry. I can't see the exact question. I thought --

MS. SOOTER: I can repeat the question.

THE COURT: Let's do that.

MR. CHU: Okay. Because I -- the scrolling went up the screen.

MS. SOOTER: Sure.

BY MS. SOOTER:

Q. What does Exhibit D-267 tell us about whether Yonah had a clock controller?

A. So I'm going to actually refer to both the whole of 14[D] and [E], the programmable clock controller having an embedded computer program therein, the computer program, including instructions, to receive the request provided by the first master device.

And so in the Yonah processor there were these model specific registers. They received the request from the operating system, and then something called micro-code -- I can't draw it very well -- does some further operations with that and it communicates to this power management logic what the ratio should be -- what the requested ratio from that core is.

Q. So based on your analysis, did Yonah have a clock controller?

A. I think the next slide will also clarify that a little.

Q. Well, let's go to the next slide and you can answer a bigger question.

Did Yonah already have a programmable clock controller?

A. Yes. It did.

Q. All right. And what does Exhibit D-267 tell you about that?

A. So it describes having programmable clock

controllers. So as it's adjusting the voltage and the -- once the ratio is communicated, the clock controllers adjust the voltage in the clock frequencies, and that's programmable.

Q. So did Yonah already have what Elements 14[D] and 14[E] require?

A. Yes.

Q. Let's take a look at Slide 73, which is showing us Exhibit D-274. Okay?

A. Yes.

Q. Well, now, what did you conclude about whether Yonah meets the requirements of Elements 14[F] and 14[G]?

A. So, again, 14[B] describes changing a clock frequency of a high-speed clock in response to a predefined change, and 14[F] and 14[G] require -- provide that the clock frequency of the high-speed clock as an output to control, a clock frequency of a second master device, and [G], provide the clock frequency the high-speed clock has an output to control the variable clock frequency of the bus, and since there's a single frequency, single clock controller, that's practiced by Yonah.

Q. And these are the requirements we were referring to, just in shorthand, earlier as the common control requirements, right?

A. Correct.

Q. And how many clock frequencies did Yonah use to control all of the components on the product?

A. One.

MS. SOOTER: Let's go to Slide 74.

BY MS SOOTER:

Q. Which of these components that we see on D-33, Page 36, were controlled by that single clock frequency?

A. All of it.

Q. And which ones in particular are relevant to your analysis?

A. The two cores, which are the two master devices, the bus, labeled the bus, and then also the L2 cache as well.

Q. And did Yonah already satisfy the requirements of 14[F] and 14[G]?

A. Yes.

MS. SOOTER: Let's go to Slide 75.

BY MS. SOOTER:

Q. What did you conclude?

A. From that I concluded that Claim 14 is invalid.

MS. SOOTER: Let's go to Slide 76.

BY MS. SOOTER:

Q. Did Yonah already do what Claim 17 requires?

A. Yes. So that's -- the instructions to provide the clock frequency of the high-speed clock as an output to control the variable clock frequency of the bus include instructions to adjust the clock frequency of the bus.

And so the writing to the MSR adjusts the clock frequency.

MS. SOOTER: Let's go to the next slide, and actually let's go ahead and skip to 78.

BY MS. SOOTER:

Q. Now, what did your analysis of Claim 14 tell you about the requirements of Claim 18?

A. So if you recall the wording between 14 and 18 is similar, it's different, but the concepts are basically the same. But so the same argument would follow if we went through step by step, but there is -- are two different elements in Claim 18.

Q. What do we still need to talk about for Claim 18?

A. Claim 18 describes an arbiter coupled to the bus and coupled to the first master device, the arbiter configured to control flow of data on the bus and a clock controller coupled to the arbiter and coupled to the first master device.

Q. Looking at Slide 79, did Yonah already have what elements 18[C] and 18[D] require?

A. Yes. Exhibit D-281 is sort of like a blueprint or a schematic of the high-level parts of Yonah, so this part here is -- that's Core 0, I think.

This would be Core 1, and then Intel had already -- this yellow box was written there by Intel. This is the bus component, and the box is pointing to a single part of the bus.

Q. So did Yonah already do what Claim 18 requires before the '759 patent was filed?

03:03 A. Yes. What Intel was pointing to there was the router -- that's what they call it -- arbitrates between requests between the different cores.

03:03 MS. SOOTER: Let's move ahead to Slide 81, please.

03:04 BY MS. SOOTER:

03:04 Q. Did Yonah already do what Claim 24 required?

03:04 A. Yeah. So 24[B] requires then the predefined -- in addition, the predefined change in the performance of the first master device comprises a variation in load of the first master device, and Yonah had that.

03:04 MS. SOOTER: Let's go to Slide 83.

03:04 BY MS. SOOTER:

03:04 Q. What do we see here?

03:04 A. So, again, this is an illustration of the way that the clock control works in Yonah on the left.

03:04 So the operating system makes a request through the model specific registers, rattles around. It goes to the PML. The PML then changes the single clock. That changes the clock frequency to control the bus and the clock frequency to control the cores.

03:04 Q. And which came first?

03:04 A. Yonah.

03:04 MS. SOOTER: Let's look at Slide 84.

03:04 BY MS. SOOTER:

03:04 Q. What do we see here?

A. This is the prior art that the Patent Office considered.

Q. Did this come right out of the '759 patent?

A. Yes.

Q. According to this list, does it appear that the Patent Office considered Yonah when deciding to grant this patent?

A. No. They would have listed it if they had.

Q. And looking at Slide 85, what did you conclude?

A. That all of the asserted claims are invalid.

Q. Professor Grunwald, can we shift gears?

A. Yes, please.

Q. Now, were you here for Dr. Conte's and Dr. Annavaram's testimony about the value they said the '759 patent provides?

A. Yes.

Q. Do you agree or disagree with their analysis?

A. I disagree.

Q. Does the '759 patent provide any value to Intel?

A. No. First because the Lake series products don't infringe the patent.

Q. And is the patent valid?

A. And the patent's not valid so that's another reason.

Q. Now, to be clear, did Dr. Conte or Dr. Annavaram ever measure the value of the patent itself?

A. No. They measured the value or the benefits of Dr. Rotem's algorithms as implemented, the Speed Shift features.

Q. Have you seen any evidence that any of the prior patent owners have ever tried to measure the benefits provided by the '759 patent?

A. No.

Q. Now, in just a little more detail, what did Dr. Annavaram set about to measure?

A. So Dr. Annavaram was asked by Dr. Conte to measure the power to the ring as a fraction of the processor.

Q. Can you think of a logical reason why Dr. Annavaram or Dr. Conte would have chosen to base the value of the '759 patent on a variable speed ring?

A. No. Because variable speed rings have been known for -- or variable speed networks and so forth have been known for a long time. Even Yonah had those. The variable speed bus in Yonah.

Q. So do you agree with Dr. Conte's underlying assumption that the benefit of the '759 patent should be measured in any way based on the variable speed ring?

A. No.

Q. So once they did set about to measure the benefit of the variable speed ring, did they do it right?

A. No. They measured the wrong thing using the wrong

tool.

Q. Well, let's talk about that just for a moment.

MS. SOOTER: Can we look at Slide 86, please?

BY MS. SOOTER:

Q. When you say they measured the wrong thing, what did they set about to measure the benefit of?

A. So what Dr. Conte had requested Dr. Annavaram to measure was to measure the power of the ring, the variable speed ring as a fraction of the package of the overall processor.

Q. What did they actually measure?

A. So what they actually measured was the power, or energy really, of the -- what's called the ring domain, which includes much more than just the ring. And they measured that as a fraction of just part of the chip.

Q. So what was the effect of these testing flaws?

A. Well, I think that it would inflate the significance of the scale of the number.

Q. You said it would have inflated --

A. Increased it. Yeah.

Q. -- inflated the value of the variable speed bus?

A. Yes.

Q. Was that correct?

A. Was that the right thing to do?

Q. Right.

A. No.

Q. Now, do you recall which Intel product Dr. Annavaram tested?

A. For purposes of this, I think initially Whiskey Lake.

MS. SOOTER: Can we please turn to Slide 87?

BY MS. SOOTER:

Q. Did you identify any analysis with the testing of the Whiskey Lake product?

A. Yeah. Now, so when Dr. Rotem was talking, he mentioned, oh, Skylake has four cores.

Well, the Skylake is a big family of products. The Whiskey Lake configuration that they examined had two cores, a GPU and then the -- all the other stuff, the cache and everything else.

But there are many different configurations of the Lake series products, everything from the two-core version that was measured to sort of like, you know, I think my laptop at the time had the four cores to -- and I think Dr. Conte used the phrase "big iron servers" that might have 24 cores or more.

Q. Would all of these products have the same percentage of power usage that should be attributed to a ring?

A. No. And to push an analogy probably further than anybody wants to hear, what Dr. Annavaram measured is like a Ford Fiesta. So two cores, kind of underpowered, you'd be thankful to have it, but, you know, it's not going to be the

ride. The four-core thing is more like a Ford Taurus, perfectly wonderful for getting the work done. The big iron's like an F150.

They're not alike in any way. And there's obviously different volumes of sales and everything else about those, but only the one was measured.

Q. If I told you I drove a Ford Fiesta --

A. Oh, really?

Q. -- would you judge me?

So do you agree that -- with Dr. Conte's conclusion that the variable ring frequency in Intel's products results in a 1.11 percent performance to power benefit?

A. No. I would disagree.

MS. SOOTER: Now, let's go to Slide 88.

BY MS. SOOTER:

Q. Can you remind us who VLSI bought the '759 patent from?

A. They bought it from NXP.

Q. And what is NXP again?

A. They're a semiconductor microprocessor company.

Q. Now, Professor Grunwald, have you heard testimony in this trial about how competitive the semiconductor industry is?

A. Yes.

Q. And how competitive is it?

A. Very competitive.

Q. Have you seen any indication that NXP used this patent?

A. No.

Q. And how did that inform your opinions about the value of this patent?

A. I would assume that a valuable patent is used.

Q. And you mentioned that you believe Dr. Annavaram used the wrong tool to measure performance. What did you mean by that?

A. Yes. Dr. Annavaram used the Fox2 tool, which Dan Borkowski discussed as being a debugging tool. So it's not an accurate power model.

Dr. Annavaram did use an accurate power model for some other studies, but not for this.

Q. So would it have made sense for you to try and recreate tests with the Fox2 tool?

A. No. It's the wrong tool for the job.

MS. SOOTER: Now, let's take a look at Slide 89. Just a couple more questions for you, Professor Grunwald.

BY MS. SOOTER:

Q. Can you please summarize your opinion as to whether Intel's Lake products infringe the '759 patent?

A. The Lake products don't infringe.

Q. And can you please summarize your opinions about whether or not the '759 patent claims are valid?

A. The asserted patent claims are not valid.

MS. SOOTER: Pass the witness.

Thank you, Dr. Grunwald.

THE COURT: Ladies and gentlemen, it is 3:12. We'll take a recess until 3:30. Remembering my instructions not to discuss the case amongst yourselves, you are dismissed until then.

THE BAILIFF: All rise.

(Jury exited the courtroom at 3:13.)

THE COURT: You may be seated.

Is there anything we need to take up during this break?

MR. CHU: It's not a matter that we must take up during this break, but just to signal for the Court, there was quite a bit of claim construction by itself, as well as claim construction and prosecution history estoppel testimony from the Q and A with this witness.

THE COURT: I understand that's your position. Is there any other issue we need to take up?

MR. HEINRICH: Yes. So our understanding is that after Dr. Grunwald finishes, Intel is going to show a series of deposition videos. And a number of them are from the witnesses that we had the Fortress issue excluded. And we just haven't gotten the revised playlists.

MR. LEE: I can make -- I can respond to each of these. The first is after Dr. Grunwald's done, we're not going to play

any deposition clips in light of Your Honor's ruling. We'll go to Mr. Huston. He'll be our last witness, and then we'll rest. As to --

THE COURT: "Rest" as in done with the trial?

MR. LEE: Done with our part of the case. I think we have to come back for the rebuttal.

(Laughter.)

THE COURT: You took me off guard.

MR. LEE: I'd have a very unhappy client if I sort of left.

THE COURT: I would be unhappy too. I would hate to lose your company.

MR. LEE: We will -- after Mr. Huston, we will rest. And so I was waiting -- I was going to tell Mr. Heinrich at the break because he'd asked me earlier, but we're not going to play any clips.

THE COURT: So we have one witness after this gentleman?

MR. LEE: Before we rest. That's correct.

THE COURT: Very good. What I am -- depending on how it goes, what I anticipate we'll do is try -- depending on how long this witness takes, because we'll start at 3:30, we'll -- do you think we'd be able to finish your last witness today?

MR. LEE: Your Honor, I think we'd have to go longer, Your Honor. The direct -- he's our damages witness, so he'll probably be on direct for an hour.

THE COURT: I don't want to do that. Thank you. All you had to do was say damages witness, and I should have realized that's who it was going to be.

We'll start with him Monday. And then we'll do the rebuttal case and then we'll have closing arguments.

MR. LEE: And we still anticipate doing it all on Monday?

THE COURT: Yes, sir. I definitely am not going to break your damages guy up. If you would like, but there's no point, I mean, you could certainly put him on and qualify him up, but I don't know that'd make -- I mean, that would be fine with me.

MR. LEE: We'll plan to do that if there's time, Your Honor, just to save the five or ten minutes.

THE COURT: That'd be fine with me.

MR. LEE: We'll plan to rest when he's done, have their rebuttal case and then close.

THE COURT: Perfect.

MR. LEE: Thank you.

THE COURT: And then we're going to take up -- I'm reading through your jury charges, and so we'll do that this evening as well.

Is there anything else -- I know we have exhibits too, but we can do those a little bit later as well, I think.

MR. LEE: Your Honor, just to respond, these issues are not claim construction issues. They're plain meaning issues. They're being tried the way plain meaning issues are tried.

THE COURT: I understand that's your position as well.

And so, Mr. Chu, who's going to cross-examine the good doctor?

MR. CHU: We were playing paper, rock, scissors. I lost.

THE COURT: Does that mean you're doing it or not?

(Laughter.)

MR. CHU: That means I'm doing it.

THE COURT: Very good. I look forward to it, and I'm sure people all over America who are listening in -- won't say who, but I have a friend who is -- literally while he is skiing, he is listening to this trial, which is kind of sad.

(Laughter.)

MR. LEE: Your Honor, I just want to make sure that if he hits a tree, we're not responsible.

THE COURT: I'll get him to sign -- I'm worried -- I should be worried now that I'm responsible. But so you all ought to know that the interest in this case is -- oh, let me ask you this: There are those who wanted to listen in as well to the arguments on the jury charge, which sounds fine to me. I think it can be -- we're going to do it out here, but apparently there is great interest in hearing that as well, which I'm fine with if you all are. It's, I would think, all public record.

MR. LEE: If it's all right with, Your Honor, we may have some people stay here to argue the jury charge and some of us

go back --

THE COURT: Anyone -- look, I don't want to be here. But -- so I get it. Anyone -- that's the one we really need to do paper, rock and scissors, and then I would know.

All I care about is if you all are okay, I'm going to do it in the courtroom because of COVID. Ordinarily I would do it back in my chambers, but I'm going to do it out here for that reason. And if you don't mind, I'll keep it on the public record as well.

MR. LEE: It's fine.

MR. HEINRICH: It's fine with us. I can't fathom anyone listening to that, but that's fine with us.

THE COURT: You would be amazed, I assure you. So we'll start back up at 3:30.

(Recess taken on 3:18 to 3:32.)

THE BAILIFF: All rise.

THE COURT: You may be seated.

Ladies and gentlemen, let me tell you the way I handle my charge conference.

The charge conference tonight is not on the record. I understand you all need to put objections on the record, and we will do that at the close of evidence on Monday. And you can put down whatever you'd like on the record, all the things -- Mr. Chu, you get to say all the things I did wrong, Mr. Lee gets to say all the things I did wrong on the record at the

close of evidence. If for no other reason, I may change my mind based on what happens between now and then.

But before I give the jury the -- before I charge them, I will give you all the opportunity to make whatever objections on the record that you want to the -- tonight's just the negotiation to try and get a final rough draft, if that makes sense.

THE BAILIFF: All rise for the jury.

(The jury entered the courtroom at 3:34.)

THE COURT: You may be seated. The good doctor will return to the witness stand.

You may proceed, sir.

MR. CHU: Thank you very much, Your Honor.

Good afternoon, ladies and gentlemen.

CROSS-EXAMINATION

BY MR. CHU:

Q. And good afternoon to you, Doctor.

A. Good afternoon.

Q. In your testimony about the '759 claims you discussed the word "request"; is that correct?

A. Yes.

Q. And you would agree that the word "request" can mean a number of different things, correct?

A. Yes.

Q. And that's -- in human language the word "request"

can mean a number of different things, correct?

A. Yes.

Q. So too in computer language, applying the English word "request" might mean this or that, depending on one's point of view?

A. Yes.

Q. And when you were doing your expert report, you thought an analogy would be helpful, correct?

A. Yes. I think so.

Q. And that provided a means for understanding the meaning you, individually, were giving the word "request," correct?

A. Yes.

Q. And your analogy had to do with a restaurant; is that right?

A. Yes.

Q. And it had to do with customers in a restaurant who finished their meal can request the check by asking the waiter to bring the bill, correct?

A. Yes.

Q. Saying, "check, please" would be a "request" to the waiter to bring the check. In other words, you had in mind an express, an explicit, a direct command or request for the check?

A. Yes.

Q. Alternatively, you said that a waiter might periodically monitor a table to see if it looks like the customers are finished eating. And based on seeing that they looked done or restless or bored, bring them the check. That was part of your analogy, correct?

A. Yes, that's correct.

Q. But appearing done or restless or bored is not a request, that's your point of view?

A. Yes.

Q. It is information that someone else may use to take action, but it's not a request. That's your analogy?

A. Yes.

Q. And I didn't leave anything out of your analogy?

A. I would need to go back to the report to -- I don't think so.

THE COURT: I'm sorry. I couldn't hear your answer.

BY THE WITNESS:

A. Sorry. I don't think so.

THE COURT: Thank you.

BY MR. CHU:

Q. If the customer is in a restaurant, sits down and says to the waiter, "I don't have any silverware," from your point of view, that's not a request because it's not an express and specific command or request for silverware. It's just a statement of condition, "I don't have any silverware."

Is it correct under your analogy when the customer says, "I don't have any silverware," that is not a request? Is that correct?

A. No.

Q. So if the customer just reports a state or condition, that is a request; is that correct?

A. No.

Q. You would say that if the customer in your analogy just said, "I don't have any silverware," that would be a request, correct? Can you answer that yes or no?

A. Just a second. So could you repeat the question again?

Q. If the customer in your analogy says, "I don't have any silverware," you would say that is a request; is that correct? Can you answer that fairly yes or no?

A. Yes. It could be.

Q. No. I'm not asking whether it could be.

Again, in your analogy the customer says to the waiter, "I don't have any silverware." Is that a request by your analogy? Yes or no.

A. Yes.

Q. And you would agree that a customer saying, "I don't have any silverware" is not the customer asking specifically for silverware; is that correct?

A. No.

Q. So a statement of a condition is sufficient to be a request in your analogy, correct?
A. No.
Q. The observation by the customer that he does not have any silverware is a statement of condition, correct?
A. Yes.
Q. And you said that a statement by the customer, "I don't have any silverware," is a request as you have used it in your opinion; is that right?
A. Yes.
Q. So a statement of a condition can be a request; is that correct? Yes or no.
A. I can't really answer that with just a yes or no.
Q. I'll ask you just a slightly different question.
A statement of a condition could be a request depending on the circumstances? Yes or no.
A. Yes.
Q. If a customer says to the waiter who hasn't given the customer a check yet, "can you please ask the valet to get our car," by your analogy is that a request? Yes or no.
A. Yes.
Q. And in that example the customer never said, "please give me the check," which by your analogy was necessary to be a request -- let me back up.
Under all circumstances, if the customer just said, "can

you please ask the valet to get our car," you would always consider that to be a request even though the customer never asked for the check; is that correct? Yes or no.

A. I can't really answer that yes or no.

Q. So if the customer says, "I want X" -- in this case the car -- it might or might not be a request for Y -- the check, depending on the circumstances, correct?

A. Yes.

Q. Our poor customer who started out without any silverware after being seated says to the waiter, "I dropped my napkin, sir," and then goes on chatting with his friends. By your analogy, is that a request? Yes or no. Can you fairly answer that yes or no?

A. It's not really a yes-or-no question.

Q. Because the customer who says, "I dropped my napkin" is providing information about the napkin, but may not be expressly requesting a new napkin; is that right?

A. Yes, that's correct.

Q. So it might be a request or it might not be a request in your mind; is that correct? It might be a request or it might not be a request in your mind?

A. Yes.

Q. And if the customer tells the waiter, "we are done eating and ready to go" but doesn't request the check, is that a request for a check even though it was never expressly

requested? Yes or no. That is a request or is not a request? Yes or no.

A. That would, in that context, be a request.

Q. So again, the customer who says, "we are done eating and ready to go" is providing two pieces of information. One is about the state of how full their tummies are. They're done eating. It's just saying here's the state of affairs: We're done eating.

And second: We're ready to go. That is another statement about their current status. You would consider that always to be a request; is that correct?

A. Yes, in that example.

Q. In a computer system one part of the system may communicate information about its status to another part of a computer system; is that correct?

A. Yes.

Q. And so too with the customer in the restaurant who simply communicates information about status to the waiter, under some circumstances that would be a request for the check, correct?

A. I'm sorry. Could you break the sentence down?

Q. I think, Doctor, in response to my earlier questions you said that the customer communicating some condition or status, in your mind, would be sufficient for it to be a request, correct?

A. Yes. In certain circumstances.

Q. And the same would be true in a computer system. If one component communicates information about status, that could be a request, correct?

A. I really can't answer that question yes or no without more specifics.

Q. Well, let me give you some specifics that were not in your analogy. Because in your analogy which I was reading from your report, the waiter is just looking at the patrons at the table to see if they looked done, restless or bored.

That's correct, that's your analogy?

A. Uh-huh.

Q. And there is no direct communication from the customer to the waiter. The waiter could just be peeking out of the kitchen through the glass window, right?

A. Yes.

Q. There's no communication at all in your analogy from the customer to the waiter, and you would say that's not a request. That's what you said in the analogy?

A. Yes.

Q. But in the infringing chips, there is information that is communicated from one part of the Skylake processor to other parts of the processor; is that correct?

A. Yes.

Q. And that is a major difference between your analogy

and how you were using the word "request" and what is actually happening in the Skylake processors, correct?

A. I disagree.

Q. So you think they're the same. That is, in one case the customer, who's like one component in a processor, has no communication whatsoever with the waiter who's just in the kitchen looking out through a glass window, that that's the exact same as a customer who uses his vocal cords and communicates directly to the waiter. You consider those to be the same; is that correct?

A. No.

Q. You would say that's a material difference, correct?

A. Yes.

Q. And the issue about whether there is or is not a request in the Skylake processors does involve a situation where one part of the infringing chip is communicating to another part of the chip, correct?

A. Yes.

Q. And that communication includes at least a communication as to the exact status of the first part to the second part in the Skylake processors, correct?

A. Did you say party or part?

Q. Part.

A. Part. Yes.

Q. I want you to assume for a moment that the word

"request" in a computer system, similar to the statements from our hapless customer in the restaurant could be just a statement of condition that causes something in the computer system to happen. Can you assume that for a moment?

A. Sure.

Q. And I want you to assume that a person of ordinary skill in the computer arts would say, if the computer was designed to provide information about the state of one part of the processor to another part of the processor, and that information about the state could always cause something to happen. Are you with me so far?

A. Yes. In your hypothetical, yes.

Q. And I want you to assume that that statement of the state -- of the state or condition, if above a certain level, will always cause something to happen. Are you still with me?

A. Yes.

Q. Is considered by our person of ordinary skill in the computer arts to be a request, because that's something that always happens. Are you with me?

A. Yes.

Q. Then similar to the situation where the customer says, I don't have any silverware, which is just a statement of condition, in the computer system it would be a request, correct?

A. I disagree.

Q. But you do agree that a person of ordinary skill could consider the statement or condition of one part of the processor to another part to always cause something to happen?

A. Yes.

Q. I'd like to ask you some questions about Yonah.

MR. CHU: Go to D-273.

THE WITNESS: Will that be on the display?

MR. CHU: It should be. Can you see it?

THE WITNESS: No.

MR. CHU: It's not on your screen. I can see --

(Off-the-record discussion.)

MR. CHU: Let me do this. We'll get it fixed in a jiffy. But I'll ask you some questions as we are getting it fixed.

BY MR. CHU:

Q. There is a document. I think you've seen it, you read it and you referred to it.

The title is The Average Power Challenge Future CMP Mobile Processors. It's a 2004 July document. Does that sound familiar?

A. I really couldn't say without seeing it.

Q. Okay. So what we'll do is you should have some notebooks there and look for D-273.

Were you able to find the exhibit, Doctor? Just doing some housekeeping, I gather?

A. This is a small place.

Q. Okay.

A. The average power challenges features the CMP mobile processors --

THE COURT: Doctor, whatever you say, she has to take down. So...

THE WITNESS: Oh, I'm sorry. Yes.

BY MR. CHU:

Q. Okay. Now, go to Page 5, if you would, and on Page 5 in the middle of the page, it says, "P-state OS policy." I'll just focus and ask questions in a way I think it'll be understandable for the jury.

Do you see in the middle of the page where it says, "P-state OS policy"?

A. Yes.

Q. OS refers to operating system?

A. Yes.

Q. And what that is referring to is the Windows operating system has a policy or policies that relate to Yonah, correct?

A. Yes.

Q. Because the Windows operating system is heavily involved in speed changes in the Yonah system, correct?

A. I can't really answer that yes or no.

Q. It plays a role --

A. Yes.

Q. -- in speed changes?

A. Yes.

Q. There would be no speed changes in the Yonah system if it wasn't running the Windows Microsoft operating system, correct?

A. No. That's not correct.

Q. It would have to run some kind of software, but the Intel Yonah product would be running most frequently the Windows operating system, correct?

A. I can't answer that yes or no.

Q. Okay. So the P-state OS policy, and then it says, "Performance on demand." Do you see that?

A. Yes.

Q. And then it says, "300 to 1,000 millisecond window." Do you see that?

A. Yes.

Q. Does that -- and that refers to the fact that a speed change may occur in 300 milliseconds or 1,000 milliseconds?

A. I don't think that's correct. No.

Q. Okay. Let's just -- do you recall how quickly the Yonah processor could make speed changes or did make speed changes?

A. Yes.

Q. And how long did it take the Yonah processor to make speed changes?

A. So I don't have the precise number.

Q. Well, let me ask you some follow-up questions then.

The OS running on the Yonah processor measures the Yonah cores loading over 300 to 1,000 milliseconds time window, correct?

A. Yes.

Q. And the loading is required to make a speed change, correct?

A. Yes.

Q. So the shortest amount of time for the loading to make a speed change would be 300 milliseconds?

A. No.

Q. In normal use the loading of the Yonah processors -- excuse me.

The operating system running on the Yonah processor measures the Yonah core's loading over a 300 to 1,000 millisecond time window; is that correct?

A. That's what it says. Yes.

Q. Okay. Now, just to orient the ladies and gentlemen of the jury, if it's -- one millisecond is one one-thousandth of a second, right?

A. Yes.

Q. So a thousand milliseconds would be one second?

A. Yes.

Q. So let's just assume the Yonah processor in a given

instance took 1,000 milliseconds to change speed, that would mean it would take it a full one second, correct?

A. Yes, in your example.

Q. And let's suppose in another instance the Yonah processor took 300 million seconds to load and change speed, that would be about a third of a second?

A. Yes. In your example, yes.

Q. So we'll use the faster number, and let's suppose that the speed was being changed, and the processor's core was loading every 300 milliseconds. In general terms, that would mean that speed changes would take place about three times a second?

A. No. That's not correct.

Q. Well -- I want to make sure you have the question in mind. We were talking earlier about 1,000 milliseconds, and it would take -- under those circumstances, a thousand milliseconds would be a full second, right?

A. Yes.

Q. Okay. And I want you to just assume that Yonah with the OS running on the Yonah processor measured the Yonah's core loading at 300 milliseconds in order to make a speed change. Will you assume that?

A. It's not what it says.

Q. I'm not asking you about this particular slide. Let me start again.

It's just a hypothetical question.

A. Oh.

Q. We already talked about 1,000 milliseconds being a full second. I just want you to assume that the OS running on the Yonah processor measures the Yonah cores loading over a 300 to 1,000 millisecond time window. Will you assume that?

A. Yes.

Q. And I want you to also assume that the faster end of that would be a loading of the Yonah's core at 300 milliseconds making a speed change. Are you with me?

A. Yes, but that's not what it says.

Q. Sir --

A. Okay.

Q. -- I haven't even asked a question yet. And this is just a hypothetical question, sir.

I'm not asking you to give your interpretation of a document. Okay? Are you with me?

A. Yes.

Q. And you understand it's entirely proper during a trial to ask an expert like you hypothetical questions, correct?

A. Yes.

Q. And you just have to accept the hypothetical. You may --

A. Yes.

Q. -- like it or not.

Okay. Again, the OS running on the Yonah processor measures the Yonah's core loading over a 300 to 1,000 millisecond time window. Please assume that.

A. Okay. Yes.

Q. And please assume that at the faster end, there's this loading taking place over 300 milliseconds in order to make a speed change in the Yonah processor, correct? I mean, please just assume that. Okay?

A. Okay.

Q. And if, in fact, it takes 300 milliseconds, then the Yonah processor would be making speed changes about three times per second under that hypothetical. I'm not asking you to look at the document.

A. No, no, in your hypothetical. No.

Q. Okay.

A. I'm answering your question.

Q. Okay. And just to be certain, the hypothetical is that it would take 300 milliseconds with Yonah running the operating system to make a speed change -- let me change it slightly.

The Yonah processor running the operating system takes 300 and 33 and a third milliseconds to load Yonah's core and make a speed change.

Are you with me in the hypothetical? Sir, you keep

looking down at a document.

A. No, no. I'm trying to recall your words. Could you repeat the question?

Q. Yes. I just want you to assume that the operating system running on the Yonah processor has Yonah's core loading to make a speed change at 333.3 milliseconds. Are you with me?

A. Uh-huh.

Q. And if it takes 333.3 milliseconds to load and make the speed change, that would be three speed changes in a second, correct? Yes or no. Can you answer that yes or no?

A. I can't really answer that yes or no.

Q. And the Skylake processors, as a generalization, do make speed changes faster than Yonah; is that correct?

A. Yes.

Q. And the Skylake processors in general can make speed changes every millisecond, correct?

A. Yes.

Q. I want you to assume that the Yonah processor can make three speed changes per second but the Skylake processors can make 1,000 speed changes in a second.

Are you with me?

A. Yes. I will make that assumption.

Q. So that the Skylake processors are more than 300 times faster at making speed changes than Yonah, correct?

A. Yes, with your assumptions.

Q. And the '759 patent or the Henson patent specifically discussed the fact that Mr. Henson wanted to make faster speed changes in a processor, correct?

A. I can't answer that.

Q. Well, let me show you a part of the patent. I'll put it up on the screen. This is PTX-005. This is the Henson '759 patent, and let's go to Column 4, Lines 8 through 10.

DEPUTY CLERK: Mr. Chu, I need to reset the computer.

MR. CHU: Sure.

BY MR. CHU:

Q. Would you read what is on the screen, the full sentence that begins with the word "in" and perhaps we can yellow highlight that full sentence.

A. Well, I'll read it from her display if I can. "In a particular embodiment, the predefined time interval may vary from one microsecond to several microseconds."

Q. And a second -- a microsecond is one --

A. I'm sorry. Several milliseconds. I misread it.

Q. I'm just going to focus a microsecond for awhile. I always get mixed up because I see words like giga and nano and it sounds Star Trek-y to me, but to engineers, one microsecond is one one-millionth of a second, correct?

A. Yes.

Q. And Mr. Henson contemplated not this old technology such as distributing Netflix movies on disks through the U.S.

Postal Service, he was envisioning his invention would permit speed changes a million times a second, correct?

A. In the highlighted text, yes.

Q. And it wasn't just an offhand reference. Mr. Henson was actually claiming in the patent claims a specific embodiment that could have speed changes up to a million times a second, correct?

A. The -- yes.

Q. And, in fact, if we go to Claim 4 in the patent, this is a dependent claim that says: "The method of Claim 1, wherein the predefined time interval is from one microsecond to several milliseconds," so Mr. Henson or his employer was specifically claiming as part of the metes and bounds of the invention a way to increase speed changes a million times a second.

That's your understanding of that, correct?

A. Is there -- it's still not coming up on my display at all. Is it on everybody else's?

MS. SOOTER: Sorry. Perhaps Dr. Grunwald could use a copy of the patent so that he could see it.

THE WITNESS: Yeah. Is there a copy in the --

BY MR. CHU:

Q. There should be. Let me just read the language to you, sir. It's 10 or 12 words. We'll --

A. Yes. I see that that is in Claim 4. Yes.

04:13 Q. Okay. And Claim 4 specifically refers to one microsecond, correct?
04:13 A. Yes.
04:13 Q. And that's a specific reference for speed changes of a million times a second, correct? Yes or no.
04:13 If there is a speed change in one microsecond, that is the same as saying you can have a million speed changes in a second, correct?
04:13 A. Hang on. Is -- where's the patent in the --
04:13 Q. Exhibit 5, sir.
04:13 A. Exhibit 5?
04:13 Q. Please take your time.
04:14 A. I'm looking at Tab 5. Is that --
04:14 Q. It will be PTX-5.
04:14 With your permission, Doctor, I'll ask one of my colleagues to maybe make sure that you --
04:14 A. Yeah. PTX-05?
04:15 Q. Yes.
04:15 A. Here we go.
04:15 Q. Do you have it, sir?
04:15 A. Yes. Now.
04:15 Q. Okay. You're looking at the '759 patent, correct?
04:15 A. Yes.
04:15 Q. And you're looking at Claim 4 at the back of the patent?

A. Yes.

Q. And just so we know we're on the same page, would you read that Claim 4 beginning with the word "wherein"?

A. Yes. "Wherein, the method of" -- sorry. "Wherein, the method of Claim 1" -- "the method of Claim 1, wherein the predefined time interval is from one microsecond to several milliseconds."

Q. And the reference to one microsecond show that Mr. Henson contemplated speed changes at the time he filed his patent application of a million speed changes a second; is that correct?

Can you answer that fairly yes or no?

A. I can't fairly answer that yes or no.

Q. Thank you. Thank you, sir.

Yonah was the old way of doing things on speed changes, correct?

A. Yes.

Q. And Skylake was the new way of doing speed changes, correct?

A. Yes.

Q. And Yonah used SpeedStep, correct?

A. Yes.

Q. And Skylake used Speed Shift, correct?

A. Yes.

Q. And even the difference in the two phrases suggests

that Skylake is much faster. So instead of taking little itty-bitty steps to change speeds, instead Skylake was doing a Speed Shift, right?

A. No.

Q. Skylake was much faster than Yonah in making speed changes, correct?

A. Yes.

Q. And SpeedStep was put into a number of different Intel products, correct?

A. Yes.

Q. It wasn't limited to Yonah. It was used in a whole host of other Intel processors, correct?

A. Yes.

Q. In much the same way that the Speed Shift in Skylake was used in many other processors by different names, correct?

A. Yes.

Q. Earlier this afternoon, in response to questions from defendant's lawyer, you testified that SpeedStep was not before the Patent Office; is that correct?

Can you answer that yes or no?

A. That SpeedStep -- that a patent about SpeedStep?

Q. No, sir. Can you answer my question fairly yes or no, that you testified earlier this afternoon in response to defense counsel's question to you, in essence, that SpeedStep was not before the Patent Office, correct?

04:18 Can you answer that yes or no?
04:18 A. Can you clarify the question?
04:18 Q. Are you saying that you can't answer it yes or no?
04:18 A. Do you mean in the prior work, or...
04:18 Q. I'll ask it one more time. And you can say yes, no, or I can't answer it yes or no, okay?
04:19 A. Okay.
04:19 Q. Earlier this afternoon you expressed the view that SpeedStep was not before the Patent Office; is that correct? Yes or no.
04:19 A. I can't answer that yes or no.
04:19 Q. Thank you.
04:19 MR. CHU: So let's look at PTX-008. And we'll put it on the screen I hope. If we've been able to get the -- excuse me for just a moment.
04:19 (Conference between counsel.)
04:19 BY MR. CHU:
04:19 Q. Okay. Excuse me. I misspoke. We've put up on the screen PTX-0008-A, as in apple. Do you see that?
04:20 A. Yes. Uh-huh.
04:20 MS. SOOTER: Excuse me.
04:20 MR. CHU: Ladies and gentlemen, are your screens operating?
04:20 Great.
04:20 BY MR. CHU:

04:20 Q. Doctor, is your screen operating?
04:20 A. No.
04:20 Q. Okay. So look at the hard copy.
04:20 This is the cover sheet from the United States Patent Office and you see where it says, "This is to certify that annexed is a true copy from the records of this office of the file wrapper and contents." Do you see that?
04:20 A. Yes.
04:20 Q. And do you see it specifically references the '759 patent, the last three digits of the patent number? You see that?
04:20 A. Yes.
04:20 Q. And it was certified by the person who was the Under Secretary of Commerce for Intellectual Property and Director of the United States Patent and Trademark Office in the lower right. Do you see that?
04:21 A. Yes.
04:21 Q. You understand that file wrapper, it's a patent term to mean the official prosecution history before the Patent Office, correct?
04:21 A. Yes.
04:21 Q. So it's the original application, the response of the Patent Office, the response of the applicant to that. It's correspondence back and forth, but it's all made an official part of the record. Any member of the public can see it and

get a certified copy, correct?

A. Yes.

Q. And let's look at the patent itself on the first page. That is PTX-005, in other words, the '759 patent.

Okay. You see on the right-hand column it has "Other Publications," and under it it says "Mobile Intel Pentium III Processor Family."

Do you see that?

A. Yes.

Q. And do you recall that the Mobile Intel Pentium III Processor Family was actually called to the attention of the Patent Office by the patent applicant, Matthew Henson and SigmaTel, in this instance? Do you recall that?

A. Yes.

Q. You do know that sometimes no prior art is called to the attention of the Patent Office and the Patent Office just has to do all the work to find prior art, correct?

A. Yes.

Q. And whether no prior art is called to their attention or a lot of prior art is called to their attention, the Patent Office tries to find all of the best prior art in examining every application, correct?

A. Yes.

Q. So Mr. Henson and SigmaTel called to the attention of the Patent Office this Mobile Intel Pentium III Processor

Family, and that family used SpeedStep; is that correct?

A. I can't answer that yes or no.

Q. You can't answer it yes or no because you just don't recall one way or the other?

A. No, to give a precise answer.

Q. Okay.

MR. CHU: Let's go to PTX-0008-A.68, which is the page, and let's blow up the paragraph under "Intel Pentium III with Enhanced SpeedStep Technology," or let's -- well, yes. Let's blow that up.

BY MR. CHU:

Q. And you can see here, in the first title, there's a reference to the "Intel Pentium III with Enhanced SpeedStep Technology." You see that?

A. Yes.

Q. And now would you agree that the Patent Office had information about SpeedStep before it? Correct?

A. Yes.

Q. And so the United States Patent Office, in carefully examining Mr. Henson's application, along with Mr. Henson and SigmaTel volunteering the existence of the SpeedStep technology, concluded that the applicant was entitled to a United States patent; is that correct?

A. Yes. With this example.

Q. Thank you.

04:25 Now, you used another term earlier today referring to HWP, correct?
04:25 A. Yes.
04:25 Q. And that stands for hardware performance or hardware performance state, correct?
04:25 A. Yes.
04:25 Q. And that's internal Intel speak?
04:25 A. Yes.
04:25 Q. Okay. I'm not being critical. Because if you were in my law firm and you heard a bunch of lawyers talking to each other, you'd say, oh, my goodness, that's internal law firm speak. So I'm not being critical.
04:25 But when we see in a document HWP or HWP autonomous mode, we know that the HWP autonomous mode is referring to Speed Shift, the faster Skylake technology --
04:26 A. Yes.
04:26 Q. -- correct?
04:26 And before this new Skylake technology was introduced, Intel used what Intel called a legacy P-state control, correct?
04:26 A. Yes.
04:26 Q. And legacy referring to something in the past, the old way of doing things, correct?
04:26 A. Yes.
04:26 Q. Have you ever known a technology company, such as Intel -- or let me modify that question somewhat because you

have been studying a lot of Intel documents. That's fair, correct?

A. Yes.

Q. In connection with changes to the design of speed changes, they wouldn't give a new technology a new name, in this case Speed Shift, if it was the same as the old technology that we've called SpeedStep, correct?

A. I can't answer that yes or no.

Q. So are you saying that maybe in this particular instance the marketing folks at Intel just gave the new name Speed Shift to the old technology SpeedStep? Are you saying that? Yes or no.

A. No.

Q. Okay. You just can't answer the question as I asked it one question ago, correct?

A. Yes. That's correct.

Q. Now, I want to go to a paper of yours, and this is PTX-3695. And I can tell you the paper is "Policies for Dynamic Clock Scheduling." You're familiar with it?

A. Yes.

Q. Because you're a co-author on it, correct?

A. Yes.

Q. And in fact in response from questions from Intel's lawyer, you made a few comments about it, correct?

A. Yes.

Q. Do you have that exhibit before you?
A. Yes.
Q. Okay. And if you go to 3695.1, this is your paper, and you published -- do you recall when you published this paper?
A. The year 2000.
Q. Okay.
A. I think October.
Q. And you were writing about, among other things, how to change processor speed, correct?
A. Correct.
MR. CHU: And at 3695.1, there's a sentence that begins "we believe the decision," and if we could get that highlighted. It's second column toward the bottom.
BY MR. CHU:
Q. You see this sentence, "We believe that the decision to change processor speed and voltage must be controlled by the operating system." You wrote that?
A. Yes.
Q. The old Yonah system had processor speed and voltage controlled by the operating system, correct?
A. Yes.
Q. And you had this broad statement that to change processor speed and voltage, it must be controlled by the operating system, correct? That's what you wrote.

04:30 A. Yes. That's what I wrote.
04:30 Q. And you do research in this particular area, correct?
04:30 A. Yes.
04:30 Q. And you do your research to try and find new, improved, better systems for speed control, correct?
04:30 A. Yes.
04:30 Q. And if -- you are more than a person of ordinary skill in the art, correct?
04:31 A. Yes.
04:31 Q. And if you had any inkling of an idea of changing processor speed through some means that was different from being controlled by the operating system, you would have done the research and published on that, correct?
04:31 A. Yes.
04:31 Q. And instead, you were just making the statement that the decision to change processor speed and voltage must be controlled by the operating system which was the old legacy way of doing things, correct?
04:31 A. Yes. In this paper.
04:32 MR. CHU: Now, I'd like to go to PTX-1670-NAT.
BY MR. CHU:
04:32 Q. Okay. You've seen this paper before, correct?
04:32 A. Yes.
04:32 Q. And you testified about it earlier today, correct?
04:32 A. Yes.

04:32 Q. Okay.

04:32 MR. CHU: Let's go to Page 3, and we're going to blow up a piece of Page 3 for others that begins with "Intel Speed Shift Technology and Skylake." It's in the right-hand column under the second bullet point, "With Intel technology Speed Shift Technology in Skylake." Let's just go ahead and let's highlight in yellow the first sentence.

BY MR. CHU:

04:33 Q. So in this IEEE paper, what is stated "instead of the old Yonah technology for changing speed, Intel Speed Shift Technology in Skylake has the CPU assuming full responsibility of power, performance and energy efficiency, not the operating system." Do you see that?

A. Yes.

Q. And the reference to OS, it can be an operating system like Microsoft Windows, correct?

A. Yes.

Q. And the departure for Speed Shift technology was putting, on the processor chip, the same piece of silicon, the means to do all those speed checks, speed changes without relying on an operating system software outside, that begins outside the chip, as is the case with Windows; is that correct?

A. I can't answer that yes or no.

Q. You do agree that Mr. Henson's invention involved, among other things, a programmable clock controller having an

embedded computer program, correct?

A. Yes.

Q. And that embedded clock controller with the embedded computer program is a part of the system that is a part of the computer chip itself, correct?

A. Yes.

Q. So the programmable clock controller --

A. I'm sorry. Was that -- you mean of the patent? Sorry. I misunderstood your question. Could you ask that again?

Q. Let me see if I can get some clarity here. Let me start with the patent.

A. Yeah.

Q. I think that's where we were. Mr. Henson's invention includes a programmable clock controller, correct?

A. Yes.

Q. And it has an embedded computer program, correct?

A. Yes.

Q. And that is part of the system that is claimed by Claim 14?

A. Yes.

Q. And Skylake has a programmable clock controller having an embedded computer program on the silicon of a Skylake processor, correct?

A. Yes.

04:36 Q. And Intel -- other Lake product families all have a programmable clock controller having an embedded computer program on those same chips, correct?

A. Yes.

Q. You read Dr. Rotem's deposition testimony, correct?

A. Yes.

Q. Would you agree that the old legacy Yonah processor did not have a PCU?

A. Yes.

Q. You would agree too that the Skylake processors do have a PCU, correct?

A. Yes.

Q. And you would agree that the PCU is a programmable clock controller having an embedded computer program, correct?

A. Yes.

Q. Would you agree with the following statement: The Yonah processor did not have a controller.

Do you agree with that? Yes or no.

A. No.

Q. Would you agree with the following statement: The Yonah processor did not have a hardware controller on it. Would you agree with that? Yes or no.

A. No.

Q. I would like to read your deposition testimony. This is at Page 250, Lines 6 through 9.

Would you like to read along or I can just read it aloud?

A. 250?

Q. 250.

A. Yeah.

Q. I'm just going to read Lines 6 through 9.

Oh, I'm sorry. I misspoke. Let's see. Do you have -- let me do it this way. I think it will save time.

I meant to say Dr. Rotem's testimony. Let me read it to you, okay?

A. Okay.

Q. Question -- this is Dr. Rotem's testimony that relates directly to my last two questions to you.

Question: "The Yonah processor did not have a controller?"

Answer: "It did not have a controller. It did not have a hardware controller on it."

Contrary to your answers two and three questions ago, would you now agree with Dr. Rotem that the Yonah processor did not have a controller and did not have a hardware controller on it? You agree with that now? Yes or no.

A. No.

Q. You disagree, correct?

A. Could you repeat your question again?

Q. I will.

A. You're asking if I'm agreeing with Dr. Rotem or the

controller?

Q. I'm asking -- I'll repeat the question.

After I just called to your attention Dr. Rotem's testimony, do you agree now that the Yonah processor did not have a controller, and it did not have a hardware controller on it? Do you agree? Yes or no.

A. Yes. Yonah has a hardware controller.

Q. So you disagree with Dr. Rotem?

A. Yes. I disagree with that line of his deposition.

Q. And I'll say it again, because there were actually two sentences. The first sentence under Dr. Rotem's testimony was: "Yonah did not have a controller."

Do you agree with that sentence? Yes or no.

A. So Line 6 and 7?

Q. Sir, I'm reading from Dr. Rotem's --

A. Uh-huh.

Q. -- deposition transcript.

A. Yes. I just can't see the lines. I'm trying to orient.

Q. Do you want me to read the sentence again? It's just one sentence.

A. Yes.

Q. Okay. Six words.

Among other things, Dr. Rotem testified about the Yonah processor and he stated under oath, "it did not have a

controller."

Do you agree with that testimony? Yes or no.

A. Yes. I agree that's his testimony.

Q. No. Sir, do you agree with the fact that he was stating under oath that the Yonah processor did not have a controller? Do you agree with that? Yes or no.

A. No. I don't agree with that.

Q. And the second sentence from Dr. Rotem's testimony is about the Yonah processor, "it did not have a hardware controller on it."

Do you agree or disagree with that testimony of Dr. Rotem?

A. I disagree with that testimony.

Q. Thank you.

You were listening to Dr. Rotem's testimony in court earlier today, correct?

A. Yes.

Q. And he's been at Intel a very long time, correct?

A. Yes.

Q. And he's been the chief architect on power-related matters for Intel for a very long time, correct?

A. Yes.

Q. And he's an Intel fellow, a very esteemed position at Intel, correct?

A. Yes.

Q. And you think that you know better than Dr. Rotem on

how the Skylake processors work; is that correct?

A. No.

Q. Yes or no?

A. No.

Q. You would agree that Dr. Rotem, when he was answering these questions, knew more about Yonah than you, correct?

A. He designed it. Yes.

Q. Just to clarify, these were statements by Dr. Rotem about Yonah, and you disagree with both of the statements by Dr. Rotem about the Yonah processor, correct?

A. Yes.

Q. Thank you.

MR. CHU: Your Honor, I do know that you would like to get in as much testimony today, but I wonder if we could have a very short break. Is that possible?

THE COURT: Of course. What is your estimate for how much longer you have with this gentleman? And I don't care. I just --

MR. CHU: Yes. It could easily be an hour or hour and a half. I will use part of the break to see what I can edit out.

THE COURT: Very good. We will stand in recess for hopefully not more than ten minutes.

Remembering my instructions not to discuss the case amongst yourselves. We'll be back in ten minutes.

THE BAILIFF: All rise.

04:45 (Jury exited the courtroom at 4:45.)
04:46 (Recess taken from 4:45 to 4:58.)
04:58 THE BAILIFF: All rise.
04:58 THE COURT: Please remain standing for the jury.
04:58 (The jury entered the courtroom at 4:58.)
04:58 THE COURT: Thank you. You may be seated.
04:58 Yes, sir.
04:58 MR. CHU: Thank you very much, Your Honor.
04:58 And ladies and gentlemen of the jury, thank you. I
04:59 realize it is a Friday afternoon, but His Honor wants all of us
04:59 to work hard to finish the case by Monday.
04:59 BY MR. CHU:
04:59 Q. Doctor, I want to change the subject. This case
04:59 involves microprocessors' designs, correct?
04:59 A. Yes.
04:59 Q. And that includes cores, bus, rings, meshes, among
04:59 other things, correct?
04:59 A. Yes.
04:59 Q. And SRAM memories, correct?
04:59 A. Yes. Those are used in those.
04:59 Q. And voltage regulators, correct?
04:59 A. Yes.
04:59 Q. And microprocessor performance, correct?
04:59 A. Yes.
04:59 Q. You don't have any patents on cores, correct?

04:59 A. That's correct.

04:59 Q. You don't have any patents on buses, rings or meshes, correct?

04:59 A. That's correct.

04:59 Q. You don't have any patents on SRAM memories, correct?

04:59 A. That's right.

04:59 Q. You don't have any patents on voltage regulators, correct?

04:59 A. Yes.

04:59 Q. You don't have any patents on power savings, correct?

05:00 A. Yes.

05:00 Q. You don't have any patents on microprocessor speed or performance or performance of memories, correct?

05:00 A. Yes.

05:00 Q. I'd like to go to a different subject.

05:00 Do you have a copy of the '759 patent handy?

05:00 A. Yes.

05:00 Q. I want to go to the end of the patent where the claims are, and I want to call up Claim 14 and we'll put that on the screen for all the jurors. The entire Claim 14.

05:00 And Claim 14 is in two columns, so that's what Mr. Simmons is taking care of right now.

05:01 Doctor, do you have the patent?

05:01 A. No. What's the number again?

05:01 Q. PTX-5. I wonder, do we have an extra copy maybe?

It's the same patent we were looking at earlier.

A. Yes. Sorry, it's just...

Yes. I have it now.

Q. Okay. Your opinion is only on one patent in this case, correct?

A. Yes. That's correct.

Q. And that's the '759 patent, correct?

A. Yes.

Q. And so you studied the '759 patent backwards and forwards, correct?

A. Yes.

Q. And Claim 14 begins with the words "a system comprising." Do you see that?

A. Yes.

Q. And I don't think we need to highlight it, but it refers to, among other things, a first master device and a second master device, correct?

A. Yes.

Q. And a master device in this context is a core, correct?

A. As -- yes.

Q. And the words "a system comprising" means that a computer chip could have three master devices and still infringe, correct?

A. Yes.

Q. Or four master devices and still infringe?
A. Yes.
Q. Or many more cores and still infringe, correct?
A. Yes.
Q. So an Intel chip with 28 cores could still infringe, correct?
A. Yes.
Q. So things could be added to the elements of this patent claim and any patent claim that begins "a system comprising," and as long as all of the elements in the claim are present, the fact that one is adding additional features or elements would not change the question of whether a product infringes, correct?
A. That's correct.
Q. So you spent a bit of time earlier today talking about algorithms, correct?
A. Yes.
Q. And algorithms are in this case ways for the computer program to make decisions on whether to increase speed, decrease speed or keep it the same, correct?
A. Correct.
Q. And that there are a set of different algorithms Intel uses, correct?
A. Yes.
Q. And the fact that they use algorithms for a system

doesn't change the fact if the system meets all the other requirements of Claim 14, it would still infringe despite the fact that Intel uses its own algorithms for that system, correct?

A. Correct.

Q. Now, I wanted to ask you a question -- we're going to leave this Claim 14 up and I'll probably come back to it. You answered some questions earlier today about the clock frequency of the high-speed clock, correct?

A. Yes.

MR. CHU: Okay. Maybe we can blow up the last element of Claim 14 for the jurors that says "provide the clock frequency of the high-speed clock." If we just -- yep.

BY MR. CHU:

Q. And it states, "provide the clock frequency of the high-speed clock as an output to control the variable clock frequency of the bus." Do you see those words?

A. Yes.

Q. The Skylake processor has a high-speed clock, correct?

A. I can't answer that yes or no.

Q. In other words, it's your opinion that the Skylake processor might or might not have a high-speed clock; is that correct?

A. No.

Q. The Skylake processors have a high-speed clock, correct? Yes or no.

A. Yes. They have multiple.

Q. I'm sorry, sir.

A. Yes. They have multiple.

Q. I just can't -- you're saying yes, but I just am missing hearing the rest of what you say. Just repeat what you said, sir. It was my hearing.

A. Yes. They have multiple.

Q. Sir, if we added a third or 28 different cores, it would still infringe, correct, because it is a comprising claim?

A. Yes.

Q. Okay. So the Skylake processors have at least one high-speed clock, correct?

A. Yes. That's correct. Yes.

Q. And the high-speed clock runs at a particular speed in the Skylake processors, correct?

Sir, let me ask a very specific question. The Skylake processor has a high-speed clock that runs at 100 megahertz, correct?

A. No.

Q. Does the high-speed clock in the Skylake processor, in some states, will just be running at 100 megahertz, correct?

A. No.

Q. Are you saying that the high-speed clock of the Skylake processor never runs at 100 megahertz?
A. I can't answer that.
Q. You don't think that any of the Intel documents say what the clock speed is in terms of megahertz; is that correct?
A. No.
THE COURT: No, that's not correct or no to his question?
THE WITNESS: No. I can't say that with assurance.
BY MR. CHU:
Q. I want you to assume that the Skylake processors have a high-speed clock that runs at 100 megahertz. Will you assume that?
A. Okay. Yes.
Q. I want you also to assume that that Skylake high-speed clock always runs at 100 megahertz. Okay?
A. Okay.
Q. And I want you to assume that it has outputs that may go to different components of the Skylake system. Are you with me?
A. Yes.
Q. You have seen some documents that the output will go to cores, correct?
A. No.
Q. You've not seen any documentation that the output may go to a core?

A. No. That's correct.
Q. Okay.
MR. CHU: Let's go to D-255, Page 15 or Bates numbers ending in 4610.
BY MR. CHU:
Q. And while we're pulling that up, would you say -- oh, your screen is working.
A. Yes. Now it's working.
Q. Oh, terrific.
You see in the upper left-hand corner it has BCLK. Do you see that?
A. Yes.
Q. Okay. Maybe we can blow that BC up. Let's blow up the -- yeah, that's fine. That's fine too. Okay.
You see the BCLK there?
A. Yes.
Q. And that refers to base clock?
A. Yes.
Q. And this is a depiction of the actual high-speed clock that is in the Skylake processors, correct?
A. Yes.
Q. And you'll see on the third box on the right-hand side it says, "CPLLI." Do you see that?
A. Yes.
Q. That's a reference to the cores, correct?

A. Yes.
Q. Okay. Two boxes down you'll see another box that is CLR PLL, correct?
A. Yes.
Q. And that's a reference to the ring?
A. Yes.
Q. Correct?
Now, the CPLL[i], the little i, there it's referring to the fact that there may be more than one core. The i could be one. The i could be 28, correct?
A. Yes.
Q. The high-speed clock operating at 100 megahertz sends a signal to this bit of hardware called a PLL, correct?
A. Yes.
Q. Now, the way this operates is the signal of 100 megahertz clock goes to the PLL, and the PLL may make no change to that speed. It might just stay at 100 megahertz, correct?
A. Yes. It could.
Q. And in this case looking at this diagram, that would mean all of the cores would get the same clock speed at 100 megahertz, correct?
A. Yes.
Q. Now, that PLL, it's a little bit of hardware, correct?

A. Yes.
Q. And it's basically a multiplier in the sense that it could take the 100 megahertz and multiply it by two, correct?
A. Not exactly, but...
Q. Very close to it for all practical purposes?
A. It's a clock generator it's called. Yes.
Q. Okay. So the PLL could change the 100 megahertz clock, multiply it by two and then send out a clock frequency of 200 megahertz, correct?
A. Correct.
Q. Or it could multiply it by three or four or five or some other number, correct?
A. Yes.
Q. And if it multiplies it by five, it's sending out a clock frequency of 500 megahertz, correct?
A. Correct.
Q. But the original input into the PLL is always 100 megahertz, correct?
A. Yes. It's always the B clock.
Q. And so too with the CLR PLL for the ring. The original input into that PLL is always 100 megahertz, correct?
A. Yes. The reference clock is 100 megahertz.
Q. And then the PLL may not multiply it and send out a 100 megahertz signal, or multiply it by a factor of two, three, four, five or some other number, correct?

A. Yes.

Q. And the same is true for every one of these boxes in the right-hand column. The input that they're getting from the B clock in the upper left-hand corner is always 100 megahertz, correct?

A. Yes.

Q. Let's go back to Claim 14, and what we were looking at just a moment ago, which was that provide -- provision at the top of Column 9.

So the words in this part at the top of Column 9 of Claim 14 states, "provide the clock frequency of the high-speed clock." Do you see that?

A. Yes.

Q. So there's a high-speed clock that has an output, before it gets to any other hardware in the processor, of 100 megahertz, correct?

A. In the claim?

Q. In the claim. To start with.

A. It doesn't say 100 megahertz.

Q. The claim states "provide the clock frequency of the high-speed clock," correct?

A. Yes.

Q. In the Intel Skylake processors, the high-speed clock, its immediate output is 100 megahertz, correct?

A. No.

Q. On the line that immediately exits the high-speed clock, it is, before it gets to the PLL, 100 megahertz, correct?

A. Yes. That clock, yes.

Q. And that 100 megahertz is an output to control the variable clock frequency. There are other things that will affect the variable clock frequency, but that high-speed clock in Skylake processors is an output to control the variable clock frequency; is that correct?

A. Can you go to the figure and indicate which clock you're speaking of?

MR. CHU: Let's go back to the figure. D-255, the one we were just looking at. Okay. Let's blow up the top half.

BY MR. CHU:

Q. I'm referring to the base clock in the upper left-hand corner that sends out a signal to some of the components on the right. Do you have that in mind?

A. Yes.

MR. CHU: And let's highlight the box for the cores, the CPLLI and for the ring, CLR PLL. Do you see that?

A. Yes.

Q. Okay. The base clock sends out a 100-megahertz signal, and before it gets to some other piece of tiny, tiny, tiny hardware in the Skylake processor, it is a 100-megahertz signal, right?

05:17 A. Yes.
05:17 Q. And that signal is an output of the high-speed clock, right?
05:17 A. It is the --
05:17 Q. Can you answer it yes or no, sir?
05:17 A. No. I can't answer that yes or no.
05:17 Q. You can't answer the -- whether the 100 megahertz output of the BCLCK shown in the Intel diagram is an output of the clock; is that right? Yes or no.
05:18 A. No. It is not.
05:18 Q. It is not an output?
05:18 A. Yes.
05:18 Q. You would agree it's not an input, correct?
05:18 A. No. I would -- yes. It is an input.
05:18 Q. Well, it first is a signal that leaves the BCLCK, right?
05:18 A. Yes.
05:18 Q. And when it leaves the BCLCK on its journey to another component, it's an output of the BCLCK, correct?
05:18 A. Correct.
05:18 Q. And that's at 100 megahertz, correct?
05:18 A. Correct.
05:18 Q. And that output of 100 megahertz is used to control something?
05:19 A. Yes.

Q. I'll let you know, I'm just reading the claim language too, right? It's -- that 100 megahertz signal is used to control something, correct?

A. Yes.

Q. Okay. And the claim goes on to say "an output to control the variable clock frequency," the language we were just looking at, correct?

A. Yes.

Q. So when it gets to the PLL[i], the PLL for the cores, the signal that leaves that box in the Skylake processors might be 100, 300, 600 megahertz or some other number, correct?

A. Yes.

Q. And you would say that the way the Skylake processor for the CLR/PLL/bus, or ring, is the same. That is, the 100 megahertz signal reaches that PLL and the output may be 100, 200, 300 megahertz or some other value, correct?

A. I can't answer that yes or no.

Q. Well, let me break it up. The BCLCK will send down a wire, the equivalent of a wire, a 100 megahertz signal, correct?

A. Yes.

Q. Before it gets to the PLL it's 100 megahertz?

A. Yes.

Q. And after it gets to the PLL, the PLL may leave it at 100 megahertz or turn it into 200 megahertz or 300 megahertz,

correct? Yes or no, sir.

A. I can't answer it the way it's phrased.

Q. The exit of the signal after the PLL for the clock could be 100 or 200 megahertz, correct?

A. Yes. That's correct.

Q. And what exits to control the clock frequency of the ring, then, could be 100 or 200 or some other amount of megahertz, correct?

A. Correct.

Q. And the fact that the exit signal could be 100, 200, 300 or some other value, you would agree that describes a variable clock frequency, correct? Yes or no, sir.

A. Yes. The output of the PLL can be a variable clock frequency.

Q. Okay. So I'm going back to the claim language. This element of providing the clock frequency of the high-speed clock on an output to control the variable clock frequency, that is done in the Skylake processors, correct?

Can you answer that fairly yes or no?

A. No.

Q. There's another reference at the immediately prior element of Claim 14; is that correct?

A. Yes.

Q. Let me blow it up. "Provide the clock frequency of the high-speed clock as an output to control the clock

frequency of a second master device." Do you see that?

A. Yes.

Q. The element that we were just on was the control the clock frequency of the bus, right?

A. Yes.

Q. So we know that the bus in the Skylake processor could have a clock frequency leaving the PLL of 100, 200, 300 megahertz, correct?

A. Yes.

Q. And then here there's a reference to "provide the clock frequency of a high-speed clock as an output," exact same words we were talking about earlier, correct?

A. Yes.

Q. And so there's this 100 megahertz output of the high-speed clock in the Skylake processors. And when it goes to the particular box we were looking at that controlled the cores, it would be an output to control a clock frequency of a second master device, correct?

A. Yes.

Q. And in the Skylake processors, you could have the cores, before the signal gets to the PLLs, receive a 100 megahertz signal and change it to a 2 megahertz signal at the same time that 100 megahertz signal -- let me start again.

You have the same 100 megahertz signal leaving the base clock in the diagram we saw from Intel. And then I want you to

assume that when it leaves the PLL for the cores, it is 200 megahertz, correct?

A. Correct.

Q. And then when it leaves the PLL for the bus, it's 400 megahertz, correct? I want you to assume that.

A. Okay.

Q. So the same clock frequency of the 100 megahertz that it leaves the base clock can be converted by tiny little pieces of hardware elsewhere in the system at the same time to a 200 megahertz clock frequency and a 400 megahertz clock frequency for different parts of the Skylake circuit, correct?

Is that correct? Can you fairly answer that yes or no?

A. No. I can't fairly answer that yes or no.

Q. Thank you.

Let me ask you a few other questions in your study of the patent and the claims.

Nowhere in the claims is there any reference to a common clock. Nowhere in the claims is there a reference to a "common clock," correct?

A. Yes. That's correct.

Q. And if -- you do understand, as a generalization, that many people use the analogy of patent claims to metes and bounds for a deed for a home, correct?

A. I'm not familiar with that. No.

Q. Well, you're familiar with the fact that a deed --

A. Oh, yes.

Q. -- has this impossible language that precisely determines the boundaries of the property of a home, correct?

A. Yes.

Q. And a patent claim is doing the exact same thing except instead of doing it for real property, a home, it's doing it for intellectual property, the patent claims, correct?

A. Yes.

Q. And so the lawyers who write the patent applications try to be very careful in defining what is included and not included in the claims, correct?

A. Yes.

Q. And if they wanted to say that the same clock frequency had to be used for both the master devices and the bus, they could have said that in black and white.

An example would be a limitation that would say the master devices and the bus would always have the same clock frequency.

That would be a way to make that clear, correct?

A. Yes.

Q. But you see no language of that sort in the claims, correct?

A. Yes.

Q. Okay. I'm going to go to a diagram that I think you used, and I think it's DDX-10.87.

So it's common, engineers and others sometimes create

these abstract diagrams to illustrate a point, correct?

A. Yes.

Q. And you don't think it would be quite right if I said that your creation of this was your inventing something. You were just trying to make an illustration, correct?

A. Yes.

Q. And what you're showing here in each of these boxes is a different computer chip, correct?

A. Yes.

Q. And the dark blue squares are cores, correct?

A. Yes.

Q. So in the top left-hand corner there's a computer chip with two cores, correct?

A. Yes.

Q. Then the one immediately below it has four cores, correct?

A. Yes.

Q. And then there's this rectangular green box in each of these boxes and that is the LLC, right?

A. Yes.

Q. LLC is a kind of memory, and it stands for the last-level cache, correct?

A. Yes.

Q. And these diagrams are showing elements of different computer chips that may draw power, correct?

A. Yes.

Q. So the LLCs, the green boxes, may draw power, correct?

A. Yes.

Q. And the cores may draw power, correct?

A. Yes.

Q. And so you're saying, gee, there's some bad assumptions being made here. And you were using that in your opinion to say you can't tell what the relationship is going to be among your different illustrations, correct?

A. No.

Q. Well, you were trying to illustrate different chips, correct?

A. Yes.

Q. With different numbers of cores, correct?

A. Correct.

Q. Okay. Now, let's go to PTX-3646 at Page 7. This is an Intel document, correct?

A. Yes.

MR. CHU: And let's just blow up the box on the left-hand side as an example.

BY MR. CHU:

Q. This is a diagram of an actual Skylake server chip, correct?

A. Yes.

05:30 Q. And it is showing the cores, 18 of them, correct?
05:30 A. Yes.
05:30 Q. And it is showing the last-level cache, correct?
05:30 A. Yes.
05:30 Q. So if we look at the bottom of that diagram in green, it says "SKX Core." See that?
05:31 A. Yes.
05:31 Q. So all the cores are this green color in individual rows, and right above each one is the LLC cache, correct?
05:31 A. Yes.
05:31 Q. In fact, in the actual Intel Skylake chips, the size of the cache is proportional to the number of cores, correct?
05:31 A. Yes.
05:31 Q. And the same is true for the diagram on the right-hand side of this page, correct?
05:31 A. Yes.
05:31 MR. CHU: Now, let's call up PDX-14.1.
05:32 BY MR. CHU:
05:32 Q. On the left-hand side it's an example of two of the boxes that you used in the demonstrative that you created, correct?
05:32 A. Yes.
05:32 Q. And in both of those, as well as the other boxes, the size of the cache, the green rectangle, was not proportional to the number of cores, correct?

05:32 A. That's correct.
05:32 Q. And, in fact, it had no relationship at all to the number of cores, correct?
05:32 A. Correct.
05:32 Q. And at the same time, on the right-hand side, that involves actual Intel evidence from Intel documents, you knew that the amount of the size of the caches was proportional to the number of cores, correct?
05:32 A. Yes.
05:32 Q. And you were using your diagram, part of which is on the left-hand side, to support your opinion criticizing the work of others, correct?
05:33 A. Yes.
05:33 Q. Okay. One of the requirements of Claim 14 --
05:33 MR. CHU: If we can bring that back up.
05:33 BY MR. CHU:
05:33 Q. -- is "a programmable clock controller having an embedded computer program therein."
05:33 MR. CHU: It's in the middle there, a program -- oh, that's good enough, but let's highlight "a programmable clock controller having an embedded computer program therein, the computer program including instructions to...," and we'll stop there.
05:33 BY MR. CHU:
05:33 Q. And then those instructions need to be able to do

some things, such as receive the request, provide the clock frequency for the master devices and provide clock frequencies for the bus; is that correct?

A. Yes.

Q. All right. So it can't just be a piece of hardware. It's got to be programmable and have embedded in it a computer program, correct?

A. Yes.

Q. And the computer program must include instructions to provide these different functions, correct?

A. Yes.

Q. Okay. Now, let's go to another diagram you used that was in exhibit of D-267, and maybe you used this, the Yonah global MAS, correct?

A. Yes.

Q. And MAS is micro architectural specifications?

A. Yes.

MR. CHU: And let's go to Page 165 -- excuse me. Let's go to --

THE COURT: Counsel, could I have you up here first, and Mr. Lee up here?

(Bench conference.)

THE COURT: I'm very concerned that no one's listening at this point at 5:30 on a Friday. So while this isn't my preference, I'm going to go ahead and break for the weekend.

I think we've worn them out after a full week, and I want to make sure -- you probably wouldn't get to him -- you wouldn't finish today anyway, I'm sure.

But again, if you could, I don't want -- I want them to be listening and fresh.

So we're going to start -- I'm going to ask them to be here at 8:30 on Monday, maybe half hour that way.

MS. SOOTER: Could we just finish the cross?

THE COURT: I've been watching them. I don't think they've really been paying attention for the last 15 minutes. I'm very concerned that it's not fair that -- them or anyone that -- to keep going.

I just -- I'd like -- believe me, that would be my strong preference to do it that way. But I just don't think it's fair to anybody to -- at least two or three of them are -- they're not with us anymore.

MR. CHU: Okay.

THE COURT: So let's --

MR. CHU: Thank you, Your Honor.

(Bench conference concludes.)

THE COURT: Ladies and gentlemen, you all have put in a long week. If I thought we were going to finish in five or ten minutes, I would make it five or ten minutes longer, but I don't think that's what we're going to have here. And I want to make certain that we're all fresh and paying attention

because of the importance of these issues.

So I'm going to hold us -- I'm going to -- we're going to break. If you could, I'd like to start Monday at 8:30 and we'll finish Monday. And we'll do the closing arguments, I hope, Monday. I'm 99 percent sure of that.

We're going to continue working tonight. There's no mystery about this. What's going to happen when we finish the evidence is, I'm going to read you and give you basically the law, remind you again what the burdens of proof are and what the claims are and how you deliberate basically.

That takes a long time for us to get done well. So we're going to stay here tonight and do that. So that Monday whenever we finish with the evidence, we're going to be ready to go and then these fine lawyers are going to give their closing arguments.

So I could not tell you how much I respect you as a former -- I used to do this myself. And so I can't tell you how much I appreciate how very hard you all have worked, all five days this week, to pay attention.

It's been -- you have each amazed me. I've been watching you and I think it's just terrific for our system what you all have done. Maybe it's because the lawyers and the witnesses have been so amazing that it's helped you all pay attention closely.

We will -- if you all will be back here at 8:15 on Monday

05:39 morning, we will resume with the cross-examination of the
05:39 doctor. And then we will finish Monday afternoon.
05:39 With my great appreciation for the work you've put in this
05:39 week, you are dismissed with one more reminder, please don't
05:39 discuss the case amongst yourselves or with anyone over the
05:39 weekend.
05:39 And this is -- this may be hard on you, but I would
05:39 probably appreciate it if you would stay off social media
05:39 unless it's something where there's no chance that you would
05:39 see something about this case.
05:39 It's been reported in the Washington -- Waco Tribune.
05:39 It's been reported other places, and I don't want you to see
05:39 anything that's being published about the case other than what
05:39 you've seen in the courtroom.
05:40 So I don't know what you look at, but I'm sure if you are
05:40 doing a cooking recipe it's unlikely it'd be on that. But
05:40 please do not use social media or look at anything about the
05:40 case over the weekend.
05:40 Thank you so much for your participation this week. You
05:40 are excused.
05:40 THE BAILIFF: All rise.
05:40 (Jury exited the courtroom at 5:40.)
05:40 THE COURT: You may be seated.
05:40 Doctor, that doesn't include you. You are free to go.
05:40 Thank you. Unless you just like being seated there.

(Laughter.)

THE WITNESS: It's such a comfy chair.

THE COURT: Ladies and gentlemen, that is very unusual for me to do. However, we've had a very long week. I was worried that jurors weren't giving their full attention like we would like them to, that they did for most of the trial. And so that's the reason I took a break.

So here's what we need to do: First, time used for the plaintiffs so far is 10 hours and 18 minutes. Time used for the defendant is 11 hours and 12 minutes. So you know, we're in good shape there.

Next, I need before we leave today, I have to have -- we have to resolve what exhibits are in the record. We've got to get that done.

And then once that's done, because I won't be involved in that unless there are disputes, then we'll take them up on the record. But the first thing to do is to get everything that you all think is in the record. Make sure Suzanne knows that.

Anything that is disputed, I'll take up and I'm not sure what I can do about it, but I'll take it up.

And then we will -- I've got the jury charge in front of me, and we'll begin to go through it. I will probably -- I'll do it from here just so you all can hear me. You all won't need to go to the podium unless you -- I mean, you're welcome to sit there. You're welcome to take off your jackets. You're

welcome to take off your ties. I'm not going to wear my robe. And so we'll just work through them until we're done with the jury charge. And then we'll start at 8:30 on Monday morning.

Yes, sir, Mr. Lee?

MR. LEE: Unrelated -- well, related to the points Your Honor just identified, but just related, I think we're probably going to have some disagreement upon the scope of the rebuttal case.

They've now disclosed witnesses and a host of exhibits and, you know, for instance, for Dr. Conte who should be coming back to talk about invalidity on the -- on one patent, he has exhibits disclosed for infringement on the '373 patent. And if we're going to finish on Monday, they've disclosed four witnesses, exhibits that actually go to issues on which they bear the burden of proof.

And so we'd just like Your Honor's counsel on what is the scope. We think it should be limited to rebuttal.

And two examples. One is what I just gave you on Dr. Conte where he has infringement exhibits on the patent where there's no invalidity attack.

And the second is they have two damages folks coming back, an issue on which they bear the burden of proof. And we would be in the position where Dr. Sullivan attacked our -- or he critiqued our damages experts during his testimony. He's going to come back and do another critique.

And I don't think that's the right use of the rebuttal case. And it could take -- it would make it hard to finish on Monday.

MR. HEINRICH: So can I let Your Honor know our rebuttal case plans? So we won't be calling Dr. Sullivan back. We are planning on having two witnesses in our rebuttal case, Professor Conte, who will be addressing the invalidity issues with the '759. But he will also be addressing the arguments, the specific arguments that Intel's experts, including their fact witnesses, made on infringement issues. But we expect to be very efficient with Professor Conte's rebuttal testimony.

And then we're planning on having a short examination of Mark Chandler. That's our -- he would be rebutting Mr. Huston's licensing testimony.

Of course we haven't heard it yet, but it's our expectation that there'll be opinions to rebut based on the expert reports.

And certainly this will all be well within our time limit with some time to spare, I am projecting.

THE COURT: Well, let me -- without quite yet getting into what will be said, and what will be allowed in the rebuttal case, I'm going to -- I'm going to modify the amount of time that you all have -- I'm going to reduce the amount of time that you all have left to get -- we've got to be -- we've got to be done by 2 o'clock on Monday, to get done. That'll give

me an hour to read and each of you all time to give the closing arguments.

That gives us essentially four hours of trial time on Monday.

And so I think both sides have been diligent in their use of time.

I'm going to think for a little bit on how I'm going to divide it up, since the defendant has used slightly more time. But you've both been very good about what you've done. But we're going to finish by 2:00 on Monday.

Mr. Lee?

MR. LEE: Your Honor, whatever Your Honor decides, we'll finish in that time allocation. But to have Dr. Conte come back on infringement --

THE COURT: I understand your point, Mr. Lee. I'm --

I guess the parallel would be then after he gives his invalidity opinion, we should get a surrebuttal case, but it could be a never-ending cycle.

THE COURT: I understand.

MR. HEINRICH: He's going to be only -- sorry.

THE COURT: My understanding is that the practice of many of my brethren in other courts that have patent cases is to allow a rebuttal case even on infringement.

That is -- I've been chatting about that. That doesn't mean I'm going to do it, but I'm trying to figure out what the

right thing to do is. But that is my understanding of how most of the people who handle a lot of patent cases treat this. And so I'll -- I haven't decided.

But what we need to do right now is to argue this. What we need to do next is get the exhibit list complete. We then need to go through the jury charge and get that done.

And then I may not even decide tonight what I'm going to do, but I will certainly decide by tomorrow, so you all can be -- you have the weekend, so it's not like this is an overnight thing.

MR. LEE: One other question, Your Honor.

THE COURT: Yes, sir.

MR. LEE: Since Dr. Grunwald will now be stuck with us at the hotel over the weekend, what is Your Honor's rule on conferring and contact with the witnesses on cross?

THE COURT: You can -- you may not confer with him.

MR. LEE: Okay.

THE COURT: And again, that's why my general rule is to have -- never have this happen. I think it's so hard to have -- to put a witness in this position, because I don't think it's appropriate for you to speak to him, but I -- you know. So he's stuck here in the middle of a cross, so I'm going to not permit --

Now, that doesn't mean you can't talk to him at all, but you cannot talk to him about the case. And I think that's also

the rule a lot of places if, for example, in Delaware and others, so...

MR. LEE: We just wanted to know what rule of the roads are.

THE COURT: Yeah.

So yes, ma'am.

MS. PROCTOR: Your Honor, our associate, Jordan Nafekh, has been hoping all day to read the exhibits into evidence, and so I would just love to give him that opportunity.

THE COURT: I would hate to deny him that opportunity.

MS. PROCTOR: Thank you, Your Honor.

THE COURT: So he will do it right now. And if someone will -- from Intel will --

Mr. Mueller, is there a problem with doing it now?

MR. MUELLER: Your Honor, I'm not sure we have the latest list. They may very well have given it to us. I'm just not sure one way or the other. I would suggest that if they read it, we'll take it down, and we'll let Your Honor know at the earliest possible opportunity if there's anything that needs to be added or changed.

THE COURT: Sounds good to me.

MR. NAFEKH: Thank you, Your Honor. Ms. Proctor actually undersold my excitement. I've been looking forward to this all week.

(Laughter.)

05:49 MR. NAFEKH: So I'll read the exhibits first from Wednesday. It's PTX-77, PTX-77-NAT, PTX-814-NAT, PTX-1372, PTX-1505, PTX-2465, PTX-2477, PTX-2478, PTX-2616, PTX-2617, PTX-2618, PTX-3899, PTX-3900, PTX-3903, PTX-3904, PTX-3909, PTX-3910, PTX-3911, PTX-3912, PTX-4015, PTX-4016, PTX-4021, PTX-4026, PTX-4032, PTX-4035, PTX-4036, PTX-4112-NAT, and PTX-4125.

And then the exhibits from Thursday are PTX-3675, PTX-4448, PTX-4449, PTX-4450, PTX-4454, and D-505. Thank you.

THE COURT: I think we can all agree that was an exceptional job.

MR. NAFEKH: Thank you, Your Honor.

MR. MUELLER: And we'll check those, Your Honor, in a moment, Your Honor.

THE COURT: And, Mr. Mueller, do you have a list for us?

MR. MUELLER: We do have a list from this morning. Your Honor, if we could, we'll consolidate that with whatever we have from today and give you a complete list of all additions on top of the list that was just read for the entire week.

THE COURT: Suzanne, does that work, or do you need them today?

DEPUTY CLERK: I really need them.

(Off-the-record discussion.)

THE COURT: No. We really need whatever list you have today we need.

05:53 MR. MUELLER: Your Honor, here's what we have through yesterday.

05:53 THE COURT: Okay. Yeah. And I don't expect you to have them today -- for today. I just need what you have through yesterday.

05:53 MR. MUELLER: So the ones that we had in addition, Your Honor, to the ones that were read were D -- let me grab my glasses, Your Honor, I apologize.

05:53 D-0040, and this was used on the cross-examination of Dr. Sullivan.

05:53 MS. PROCTOR: And, Your Honor, I think we objected to that one and we provided a redacted -- a redacted version to them and we're waiting to hear back. And the same actually for the next couple, I think, on these Sullivan exhibits.

05:53 MR. LEE: No one objected when the exhibits were offered.

05:53 MS. PROCTOR: I did object, Your Honor.

05:54 MR. LEE: They've asked us in light of Your Honor's rulings to redact some things, and I think we can be able to work it out.

05:54 THE COURT: Well, then let's put them in. I'll let you attempt to work them out. If you can't work them out, I'll take it up and I might strike them from the record, but for right now we'll just put them in.

05:54 MR. MUELLER: And I think, Your Honor, the portions, if I understand correctly, that would need to be redacted are just

signature blocks so I'll read the list, Your Honor. It's D-0040, D-0044, D-0119 and PTX-4267.

And then from the list that had been provided by VLSI, there were nine that we weren't able to find an indication of on the record. I can read that list and we can continue to confer with VLSI to try to resolve this, but so the record is clear, those are PTX-814 -- and some of these may also have the redaction issues -- PTX-1372, PTX-2616, PTX-2617, PTX-2618, PTX-3819, PTX-4036, PTX-4112 and PTX-4125.

And as I said, Your Honor, in addition, we'll check their list from today and provide any changes we have as promptly as we can.

THE COURT: Okay.

MR. MUELLER: There's some more objections that, I guess, have been added to the objection list, and I'll read those. PTX-3899, PTX-3900, PTX-3909, PTX-3910, PTX-3911 and PTX-3912.

Thank you, Your Honor.

MS. PROCTOR: And just one other update on those. Other than the last six Mr. Mueller just read, Intel e-mailed us earlier today and I think we've resolved all the other objections that Mr. Mueller noted, except perhaps 4125, but I'll check on that one. Thank you.

THE COURT: Okay. Why don't we -- who is staying for this next round?

(Off-the-record discussion.)

05:56 MR. MUELLER: I'll stay, Your Honor, but Mr. Tompros will handle the argument.

05:56 THE COURT: Okay. Very good. Then give me just five minutes to go powder my nose, and I'll be back out and we'll take up the jury charge.

05:56 (Hearing adjourned at 5:56 p.m.)

UNITED STATES DISTRICT COURT)
WESTERN DISTRICT OF TEXAS)

I, Kristie M. Davis, Official Court Reporter for the United States District Court, Western District of Texas, do certify that the foregoing is a correct transcript from the record of proceedings in the above-entitled matter.

I certify that the transcript fees and format comply with those prescribed by the Court and Judicial Conference of the United States.

Certified to by me this 8th day of March 2021.

/s/ Kristie M. Davis

KRISTIE M. DAVIS
Official Court Reporter
800 Franklin Avenue
Waco, Texas 76701
(254) 340-6114
kmdaviscsr@yahoo.com